Outlines of Human Body, Physiology, Etc.

RIEGE

"The Proper Study of Mankind is Man."

OUTLINES

OF THE—

HUMAN BODY,

With Special Reference to

ANATOMY, PHYSIOLOGY,

AND

HYGIENE,

For Teachers and Students.

—o—

BY

GEORGE F. RIESE, M. S., A. M.,

PRESIDENT PORTLAND NORMAL COLLEGE,

PORTLAND, INDIANA.

PORTLAND, IND.:

Published by the Author.

1894.

Sun Book and Job Print, Portland, Ind.

PREFACE.

The *necessities* of the class room, together with the almost impulsive desires of my pupils, have urged me to write this outline, and send it forth for better or for worse. I have found it a great advantage to both teacher and pupil to have at the same time a comprehensive and a terse outline for use in school work: to the former, because it suggests exactly what is expected by that teacher; to the latter, not only because of the knowledge and instruction derived, but also because of the certainty of his study. It aids both in the classification of knowledge, one of the important factors in our system of education.

Though the outline was prepared with special reference to the needs of my own classes, I can not see why it might not prove advantageous to others.

For those persons desiring to make a hasty review of the subject, the work will be found indispensable.

The comprehensiveness of the work, together with the fact of the number of sources drawn from, ought to commend the work to all. It seeks to cover a wide range of investigation, such as one only can gather from a large and well selected library. Some things are not expected to be learned, but are rather inserted as a matter of reference. The teacher should be the judge of just how much to present to a particular class. I would however, suggest that the work be as complete as possible.

The derivation of words, because of the large per cent. of foreign words that have been introduced in some way in this subject, should receive the careful attention of every teacher. Their position in the book should serve a good purpose. Every

term should be carefully explained, especially such terms as anterior, posterior; ventral, dorsal; lateral, longitudinal; transverse, and oblique.

The book was prepared for use with Martin's Human Body, though it can be used with any good text book, by taking corresponding topics in outline and text book. The book was meant to help the text book and not entirely to supplant it. A good plan of recitation would be to assign a certain series of topics as a lesson and have pupils find all about them from whatever source they can.

It would be of great value to students and teachers to do as much work in the dissecting room as possible. Such subjects as dogs and cats are numerous, and easily obtained. The dissection of animals of this kind give you an exact and concrete illustration of many difficult points.

I wish to thank my students for their encouragement and hope the work may meet their approbation at all times.

With the hope that the text, with its generalizations, arrangement and its methods will meet the highest ideals of all those who might come in contact with it, I now humbly send it forth to do its duty.

PORTLAND NORMAL, March 4, 1894.

G. F. RIESE.

METHODS OF OUTLINING.

An examination of the partial outlines given below, will make the transition easy from the common brace system to the exponential system used in this book.

FOODSTUFFS. (1)

- (1^2) Water.
- (2^2) Common salt.
- (1^1) Inorganic.
  - (3^2) Calcium phosphate.
  - (4^2) Hydrochloric acid.
  - (5^2) Carbonate of lime or calcium.
- (2^1) Organic.
  - (1^2) Nitrogenous or azotized.
    - (1^3) Proteids. C. H. N. O. S.
    - (2^3) Peptones. C. H. N. O. S.
    - (3^3) Albuminoids. C. H. N. O.
  - (2^2) Non-nitrogenous or non-azotized.
    - (1^3) Hydrocarbons. H. O. C.
    - (2^3) Carbohydrates. C. H. O.

1. Foodstuffs.

1^1 Inorganic.
  1^2 Water.
  2^2 Common salt.
  3^2 Calcium phosphate.
  4^2 Hydrochloric acid.
  5^2 Carbonate of lime or calcium.
2^1 Organic.
  1^2 Nitrogenous or azotized.
    1^3 Proteids. C. H. N. O. S.
    2^3 Peptones. C. H. N. O. S.
    3^3 Albuminoids. C. H. N. O.
  2^2 Non-nitrogenous or non-azotized.
    1^3 Hydrocarbons. H. O. C.
    2^3 Carbohydrates. C. H. O.

For explanation, see next page.

EXPLANATION OF EXPONENTIAL SYSTEM OF OUTLINING.

The small figures to the right and a little above the large figures are used to indicate the coordination and subordination of subjects.

The coordination of subjects is shown in two ways, viz., by placing the large figures that indicate the same division in a vertical line and giving each the same exponent. The subordination is also shown in two ways, viz., by writing a subordinate subject a little to the right of its principal and increasing the exponent by unity.

The large figures in a vertical line show the number of divisions of a subject. For instance, there are two divisions of the organic, hence (2^2) under (2^1), and there are three divisions of (1^2) hence (3^3) In finding what a certain thing is a division of, determine the exponent of large figure to left and then look backward in the outline until you find the first figure that has an exponent signifying one less division than the exponent in question.

To illustrate: "Carbohydrates" has a figure (2) to the left with an exponent (^{3}). The exponent (^{3}) traces back to the first figure that has an exponent (^{2}), which we find to be (2^2). Hence we reason that "Carbohydrates" is a division of Non-nitrogenous. (1^2) and (2^3) below organic will be found upon the same principle to be divisions of (2^1), etc.

1. Human Body.

1¹ Principal sciences concerned in a knowledge of it.
1² Physiology—*phusis*—nature. *logos*— a discourse.
1³ Definition of.
2³ Divisions.
1⁴ Human.
1⁵ Definition.
2⁵ Analysis of, presents its functions.
3⁵ Basis of Hygiene for Human Body.
1⁶ Definition of Hygiene.
2⁶ Conditions by which work of the Body is best performed.
2⁴ Comparative.
1⁵ Definition.
2⁵ Value of its study in laboratory.
1⁶ Very important—Dissection of dogs, cats, frogs, etc.
3³ Connection to Biology.
1⁴ Having similar province—the discovery of laws of life.
2¹ Reaches to Biology for its basis.—[*Britanica.*]
4³ Relation to Botany, Zoology and kindred sciences.
5³ Object of physiological research, see 2¹.
6³ Controlling generalizations.
1⁴ Conservation of energy—
1⁵ Define and illustrate.
2¹ Physiological division of labor.—
1⁵ "Many hands make quick work."
2⁵ Discuss fully.
*2² Anatomy. *-ana*—through and, *tome*—a cutting.

NOTE.—
*1. Anatomy.
1¹ As to kingdom.
1² Vegetable or Phytotomy.
2² Animal or Zootomy.
1³ Comparative.
2³ Special.
1⁴ Developmental or embryological.
2⁴ Morphological.
3⁴ Teleological or physiological.
4⁴ Topographical.
5⁴ General.
6⁴ Special or microscopic.
7⁴ Morbid or pathological.

1[3] Definition.
2[3] Divisions.
1[4] As to subject treated.
1[5] Human.
2[5] Comparative.
3[5] Pathological.
2[4] As to structure.
1[5] Gross or general anatomy —general structure.
2[5] Microscopic or histological—histology: *histos*—a web. and *logos*—a discourse.
3[3] Value of anatomy———basis of physiology and hygiene.
3[2] Hygiene.
4[2] Chemistry—*ultimate elements.*
2[1] Objects to be gained by its study.
1[2] Intellectual growth.
2[2] Derived pleasure.
3[2] General basis of science of organisms.
4[2] Healthy functions known.—self protection.
5[2] Moral growth.
3[1] Structure of the human body.
1[2] Special or histological—minute anatomy.
1[3] Object—minute composition of tissues.
1[4] Tissues.
1[5] Definition.*
2[5] Classification.
1[6] As to function—founded on physiological division of labor.—
1[7] Undifferentiated.
1[8] Example—lymph-corpuscle and colorless-corpuscle of blood.
2[7] Supporting tissues.
1[8] Cartilage—gristle.
2[8] Bony or osseous tissue.
3[8] Connective tissues proper.
1[9] Fibrous.

*A tissue is a cell or combination of cells that either have a certain function or a certain structure, used as a primary condition for building up the Body.

1[10] White fibrous –non-elastic.
1[11] Different forms.
1[12] Membrane.
1[13] Cellular.
2[13] Serous.
3[13] Dermoid.
4[13] Mucous.
5[13] Synovial membrane.
2[12] Tendon.
3[12] Ligament.
2[10] Yellow fibrous.
1[11] Characteristic property—elasticity.
2[9] Areolar.
3[9] Cartilaginous.
3[7] Nutritive tissues.
1[8] Assimilative.
1[9] Secretory.
1[10] Cells secreting digestive fluids.
2[10] Receptive—cells taking up digested material.
2[8] Eliminative—cells of kidneys, skin, and others.
3[8] Respiratory—cells lining lungs and also colored corpuscle of blood.
4[8] Classification artificial—every cell really performs, assimilation, respiration, and elimination.
5[8] Make up "organs of vegetative life."
4[7] Storage tissues.
1[8] Adipose, } Together with secretory and excre-
2[8] Liver cells. } tory called metabolic.
3[8] Capitalists of Body.
5[7] Irritable tissues.
1[8] Nerve fibers as a whole—sense organs.—
2[8] Compared to the agents of a government.
6[7] Co-ordinating or automatic.
1[8] Nerve cells—compared to central government.
7[7] Motor tissues.
1[8] Ciliated cells.
2[8] Muscular tissues.
1[9] Striated.

2[9] Non-striated.
8[7] Conductive tissues.
1[8] Nerve fiber.
2[8] Product—nervous impulse.
3[8] Irritable tissues connected to automatic, etc.
9[7] Protective.
1[8] Epithelial cells.
2[8] Epidermis.
3[8] Hairs.
4[8] Nails.
5[8] Enamel of teeth.
10[7] Reproductive.
1[8] Kinds—two.
2[6] As to structure—anatomical.
1[7] Primary—8.
1[8] Connective tissues—proper.
1[9] Fibrous.
1[10] Kinds.
1[11] White.
1[12] Forms gelatine by boiling.
2[12] Different forms.
1[13] Membrane.
1[14] Cellular.
2[14] Serous.
3[14] Dermoid.
4[14] Mucous.
5[14] Synovial.
6[14] Layers of.
1[15] Epithelium.
2[15] Endothelium.
2[13] Tendon.
3[13] Ligament.
3[12] Parts affected in rheumatism—hence swelling of joints.
4[12] Collagen—changes to gelatine by boiling.
5[12] Characteristic property—non-elasticity.
2[11] Yellow.
1[12] Characteristic property—elasticity.

2[9] Areolar.
1[10] Made of white and yellow fibrous tissues.
2[10] Not affected by sensibility or contractility.
3[10] Dropsy—feet swelling.
4[10] Suffocation produced by inflation of Body through accidental opening from lungs.
5[10] Inflation of butcher's meat.
3[9] Cartilaginous.
1[10] Kinds, as to time of lasting.
1[11] Temporary.
1[12] Changes to bone.
2[12] Made up of hyaline cartilage.
2[11] Permanent.
1[12] Calcification of, in old age.
2[10] Kinds, as to structure.
1[11] Cellular or parenchymatous.—[*Britanica.*]
1[12] Not found in adult.
2[12] Cartilaginous framework of ears of mouse and rat possess it.
2[11] Hyaline.
1[12] Forms cellular but includes more: found in adult.
2[12] Examples.
1[13] Encrusting cartilage at the articular ends of bones.
2[13] Cartliages of nose.
3[13] " " windpipe except epigloitts and cornicula laryngis.
3[12] Its purity as a type.
3[11] Fibro-cartilage
1[12] Kinds.
1[13] White.
1[14] Examples—intervertebral disks and cotyloid ligament.—[*Encyclopedia Britanica.*]
2[14] Non-elastic.
2[13] Yellow elastic fibro-cartilage.
3[10] Perichondrium—covering of cartilage.
4[10] A non-vascular tissue in adult.

5[10] Development.—
2[8] Other primary tissues.
1[9] Adipose tissue—fat.
1[10] Where found?
2[10] Serves as stored up material for future use.
3[10] Earliest removed in disease.
4[10] A non-conductor of heat.
5[10] Gives roundness and beauty to the Body.
2[9] Sclerous or osseous tissue proper.
1[10] Found in bones and teeth.
2[10] Hardest of all tissues.
3[9] Muscular.
1[10] Kinds of fibers.
1[11] Striated.
2[11] Non-striated.
2[10] Properties of——
1[11] Elasticity.
2[11] Tonicity.
3[11] Sensibility of peculiar kind—muscular sense.
4[11] Contractility.
5[11] Irritability.
4[9] Tubular.
1[10] Capillaries.
5[9] Nervous.
1[10] Characteristic property—sensibility.
2[10] Composition.
1[11] Nerve fibers.
2[11] " cells.
3[10] Kinds.
1[11] Gray or vesicular.
2[11] White.
3[5] Product of tissues in combination.
1[6] Organs.
2[6] Human Body, man—an organism.
1[7] Kingdom—Animal.
2[7] Sub-kingdom—Vertebrate.*
3[7] Class—Mammalia.
1[8] Why?

1[7] All Mammals possess midriff or diaphragm.
2[9] All Mammals possess mammary glands.
4[7] Order—Primate.
1[8] Why?
2[2] General structure—gross anatomy.
1[3] Of Human Body.
1[4] How is knowledge of, obtained?
1[5] Cross sections.
2[4] Product of knowledge of Body.
1[5] Axial division.
1[6] Head.
1[7] Cavities in it.
1[8] Mouth.
2[8] Nasal.
3[8] Part of dorsal or neural.
2[6] Trunk.
1[7] Cavities of.
1[8] Ventral or haemal.
1[9] Divisions.
1[10] Thoracic.
1[11] Contents.
1[12] Heart.
2[12] Lungs.
3[12] Oesophagus.
4[12] Trachea in part.
5[12] Bronchi.
6[12] Blood vessels.

NOTE.
2*1 Other divisions.
1[1] Mollusca.
1[2] Snails, slugs, clams, oysters, etc.
2[1] Arthropode.
1[2] Flies, moths, spiders, centipedes, lobsters, etc.
3[1] Vermes.
1[2] Worms.
4[1] Echinodermata.
1[2] Sea urchins, star fishes, etc.
5[1] Caelenterata.
1[2] Sea anemones.
6[1] Protozoa.
1[2] Microscopic animals.

7[12] Lymphatic vessels.
8[12] Part of sympathetic nervous system.
2[11] Cavity does not extend into neck—Mouth and nose lead into hollow material located within neck, etc.—Ventral cavity perfectly closed.
2[10] Abdominal.
1[11] Contents.
1[12] Stomach.
2[12] Intestines.
3[12] Kidneys.
4[12] Liver —hepar.
5[12] Spleen.
6[12] Pancreas.
7[12] Omentum.
8[12] Blood vessels.
9[12] Sympathetic nervous system in part.
10[12] Lymphatic vessels.
3[10] How divisions are made?
1[11] Midriff or diaphragm.
1[12] Possessed by all Mammalia.
2[9] Ribs, muscles, sternum, and spine in making it.
2[8] Dorsal or neural.
1[9] Extends into head.
2[9] Shape.
3[8] Contents.
1[10] Most important nervous organs.
1[11] Brain.
2[12] Spinal cord.
2[5] Appendicular divisions.
1[6] Extremities.
1[7] Upper.
1[8] Pectoral arch or shoulder girdle.
2[8] Upper limbs.
2[7] Lower.
1[8] Pelvic girdle.
2[8] Lower limbs.
3[5] Distributed through the Body.
1[6] Arteries.

2[6] Veins.
3[6] Muscles.
4[6] Glands.
5[6] Nerves.
6[6] Lymphatic vessels.
3[4] Systems of human body.
1[5] Osseous—bones.
2[5] Articulatory—joints.
3[5] Muscular—muscles.
4[5] Vascular—blood and lymph vessels.
5[5] Digestive—alimentary canal and glands.
6[5] Respiratory—lungs and windpipe.
7[5] Urinary—kidneys, bladder, ureters, and urethra.
8[5] Tegumentary—skin, hair, and nails.
9[5] Nervous—brain, spinal cord, and nerves.
10[5] Generative or reproductive.
2[3] Of other bodies.
1[4] Of snails and river mussels.
1[5] No axial skeleton or axial nervous system.
2[5] Nervous system scattered through the Body.
2[4] Of worms and insects.
1[5] Head, trunk, and extremities present.
2[5] No axial skeleton.
3[5] Axial portion of nervous system on ventral side.
3[4] Fresh water hydra.
1[5] No body cavity, digestive cavity a depression in the Body.
2[5] No nervous muscular, or vascular system.
4[4] Amoeba.
1[5] Moves by pseudopodia or by false feet thrown out.
2[5] Ingulfs its food.—No alimentary canal.
3[2] Terms necessary for true description of position.
1[3] Anterior and posterior.—[*Britannica.*]
2[3] Prae-axial and post-axial.
3[3] Atlantal and sacral.
4[3] Ventral and dorsal.
5[3] Lateral, transverse, longitudinal and oblique.

1. Elements of a logical definition.
1' Subject.
2' Copula.
3' Genus.
4' Specific difference.

DEFINITIONS WRITTEN ACCORDING TO ABOVE PLAN:

(*a*) *Physiology is that science which treats of the functions, properties and actions of the various organs of a living body.*

(*b*) *Anatomy is that science which treats of the structure of the various organs or parts of a body.*

(*c*) *Hygiene is that science which treats of the laws and conditions of health of a living body.*

(*d*) *Histology is that science which treats of the minute structure of the various organs of a body.*

(*e*) *A tissue is a cell or combination of cells that either have a certain function or a certain structure used as a primary condition for building up a body.*

(*f*) *Chemistry is that science which treats of the simple and compound elements in nature.*

1. Anatomy—Gr., *ana*, through, and *tome*, a cutting.
2. Adipose—Lat., *adeps*, animal fat.
3. Biology—Gr., *bios*, life, and *logos*, a discourse.
4. Bone—Lat., *osteon*.
5. Cellular—Lat., *cellula*, a little cell.
6. Corpuscle—Lat., *corpusculum*, diminutive of *corpus* a body, hence little body.
7. Chemistry—Ar., *kimia*, hidden art.
8. Dermoid—Gr., *derma*, the skin, and *eidos*, form.
9. Epithelium—Gr., *epi*, upon, and *tithemi*, discover or place.
10. Histology—Gr., *histos*, tissue, and *logos*, a discourse.
11. Hygiene—Lat., *Hygeia*, the goddess of health.
12. Lymph—Lat., *lympha*, water.
13. Oesophagus—Gr., *Ois*, to carry, and *phagein*, to eat.
14. Physiology—Gr., *phusis*, nature, and *logos*, a discourse.
15. Pathology—Gr., *pathos*, suffering, and *logos*, a discourse.
16. Pancreas—Gr., *pan*, all, and *kreas*, flesh.
17. Trachea—Gr., *trachus*, rough.

NOTE.—I shall venture a few definitions, since so many are given—that either do not include all they should, or exclude what has no relation to them. —I would urge upon teachers to give logical definitions, and teach their pupils to form the like, for this gives a knowledge not only of the specific term but the general term as well: an important point in education, so important that DeGarmo has considered it not out of place to address almost a whole book on the development of these important factors in education.

1 Microscopical and chemical composition of the Human Body.

1¹ Microscopical composition.

1² Cells—[Refer to Nicholson's biology.]

1³ Comparison to amoeba and foraminifera in general.

1⁴ Amoeba, an organism: cell of human body not.

2⁴ " takes up oxygen and gives off carbon dioxide.

3⁴ Amoeba possesses all powers of an independent organism—motion, feeling, digestion, respiration, excretion, secretion, etc.

4⁴ Amoeba an animalcule, uniceullar.

5⁴ Moves by psuedopodia, reproduces by simple division.

2³ Parts.

1⁴ Covering.

1⁵ Cell wall.

1⁶ Formed not formative.—["Dr. Lionel Beale."]

2⁶ More or less nearly dead.

3⁶ The greater the amount of cell wall the less active the functions of the cell, hence more nearly dead.

2⁴ Cell contents or parts of contents.

1⁵ Cell body.

2⁵ Nucleus.

3⁵ Nucleolus

3⁴ Comparison of parts to divisions of an egg.

3³ Cell multiplication or cytogenesis.

1⁴ Kinds.

1⁵ Endogenous.

1⁶ Cell contents divided into divisions.

1⁷ May have proper cell wall in time.

2⁷ Doubles at each multiplication: two, four, eight, sixteen, etc.

☞ I think the plan of deriving the names of scientific terms one of the most satisfactory methods of becoming acquainted with the language of science. Only the most difficult names will be given in each list. Teachers should emphasize this. The list has been placed at the close of the outline in order not to be so far removed from the subject treated, making it easier to refer to, and at the same time making it a greater likelihood that the reference will be made. The alphabetical arrangement should serve a good purpose.

2[5] Gemmiparous.
1[6] Processes thrown out.
1[7] May but do not need become detached.
2[7] Pores permitting an oozing out.—*Beale.*
3[6] Fissiparous.
1[6] Cleavage into parts.
2[6] Doubtful existence—possibly another form of endogenous.
4[4] Living cells must contain protoplasm, bioplasm, sarcode, blastema, or germinal matter.
1[4] Coagulation of, at 130° F.
1[5] Theory of prostration and fevers.
2[4] Chemical analysis uncertain.
1[5] Simple elements of—carbon, hydrogen, oxygen, nitrogen, and sulphur in various combinations.
2[5] Compounds—residues of proteids, fats, carbohyorates, salts, and water.
5[3] Elongated cells produce fibers.—
6[3] Intercellular substance.
7[3] Office of cells.
1[4] To do the work of the Body.
2[4] To determine form and size of organs.
3[4] " " the faculties of organs.
4[4] " give centers for the production of animal heat.
5[4] To give greater physiological division of labor.
1[5] Of what value is physiological division of labor?
1[6] Greater work performed.
2[6] Less time required.
3[6] Work easier performed.
2[5] Greatest in man—complex movements.
8[3] Morula—(*Martin H. B. p. 26.*)
9[3] Size from $\frac{1}{3000}$ to $\frac{1}{500}$ in.—average $\frac{1}{2000}$ in.—
10[3] Forms—various.
11[3] Make up organs and organisms.
12[3] Growth.
1[4] By interstitial deposit or intussusception and not by accretion.

13[3] Fundamental physiological properties of cells and Body.
1[4] Assimilation and dissimilation: nutrition.
1[5] Making alike and unlike.
2[4] Reproduction.
3[4] Contractility—amoeboid movements.
4[4] Irritability.
5[4] Conductivity.
6[4] Spontaneity.
14[3] Physical properties of cells and Body.
1[4] Weight.
2[4] Rigidity.
3[4] Elasticity.
4[4] Color, etc.
15[3] Groups of—(*Britanica vol. 1, p. 845.*)
1[4] 1st group—cells suspended in fluids.
1[5] In blood, lymph, and chyle.
2[5] Red, white, plaque, and lymph corpuscles.
2[4] 2nd group—cells placed on free surfaces.
1[5] Epithelial.
1[6] Tessalated, pavement, scaly, or squamous.
2[6] Columnar or cylindrical.
3[6] Ciliated.
4[6] Spheroidal or granular.
3[4] 3d group—cells imbedded in solid tissue.
2[1] Chemical composition.
1[2] Simple elements found in Human Body.* (16 2?)
1[3] Carbon 13.5 per cet.
2[3] Chlorine.
3[3] Calcium.
4[3] Fluorine.
5[3] Hydrogen 9.1 per cent.
6[3] Iron.
7[3] Lithium.
8[3] Manganese.
9[3] Magnesium.
10[3] Nitrogen 2.5 per cent.

11^3 Oxygen 72 per cent.
12^3 Phosphorus 1.15 per cent.
13^3 Potassium.
14^3 Silicon.
15^3 Sulphur.
16^3 Sodium.
17^3 Copper?
18^3 Lead?
2^2 Chemical compounds.
1^3 Very many.
2^3 Very complex—
1^4 Example—albumen, $C^{144}\ H^{110}\ N^{18}\ S^2\ O^{42}$
3^3 Classes of, in human body.
1^4 Inorganic constituents, 21.
1^5 Principal ones.*
1^6 Water—H^2O.
1^7 Average weight, $\frac{2}{3}$ of whole Body.—(*Martin.*)
2^7 Enamel of teeth contains least, 2 per cent.
3^7 Bones about, 22 per cent.
4^7 Muscles, 75 per cent.
5^7 Blood, 79 per cent.
6^7 Saliva most, 99.5 per cent.
2^6 Common salt—NaCl.—Sodium Chloride.
1^7 In all tissues.
3^6 Calcium phosphate—$Ca^3\ 2\ PO^4$.
1^7 Large quantities of in bones and teeth—less in other tissues.
4^6 Hydrochloric acid—HCl.
1^7 Uncombined in stomach.—(*Martin.*)
5^6 Potassium chloride—KCl.
1^7 In blood, muscles, nerves, and most liquids.

*Rem. 1. The student should be guided to learn as much about these elements as possible.

Rem. 2. The best way to remember the names of these elements is possibly the taking of the initial letters as initials of the words forming a sentence. I append a sentence of this kind:

Let Chas. Manganese sell his safety notes if foolish poverty-stricken sons of men pay clear cash. Crocodile Lake.

You will notice that the signature indicates the doubtful elements.

6[5] Potassium phosphate.
7[6] Carbonate of lime or calcium.
1[7] Teeth.
1[8] Corroded by organic acid—hence teeth should be kept clean.
8[6] Ammonium chloride.
9[6] Sodium phosphate.
10[6] Magnesium phosphate.
11[6] Sodium phosphate.
12[6] Potassium sulphate.
13[6] Calcium fluoride.
2[4] Organic.
1[5] Nitrogenous or azotized organic compounds.
1[6] Proteids or albuminous bodies.
1[7] Type----egg albumen.
2[7] Simple elements found in it. C. H. N. O. S.
1[8] Varies in percentage composition.*
3[7] Most important compound in Human Body.
4[7] Most important proteids.
1[7] Serum albumen.
1[8] Blood----Boil blood for test.
2[8] Fibrin.
1[9] Elements that form it.
1[10] Fibrinogen.
2[10] Fibrinoplastin.
3[10] Fibrin ferment.
2[9] Found in blood.
3[8] Myosin.
1[9] Found in muscle.
2[9] Solidifies after death—death stiffening—*rigor mortis.*
4[8] Globulin —
1[9] Found in red globules of blood.

*1. Variation Table.
1[1] Carbon 52-54 per cent.
2[1] Hydrogen 7-5 per cent.
3[1] Oxygen 21-24 per cent.
4[1] Nitrogen 15-17 per cent.
5[1] Sulphur .8-2 per cent.

2⁹ Joins with a colored substance to form *haemoglobin*.

5⁸ Casein.

1⁹ Found in milk—curd.

1¹⁰ Precipitated when alkali is neutralized.

2⁹ Principal constituent of cheese.

5⁷ Test.—Subnitrate and pernitrate of mercury plus proteid gives pink precipitate or solution.

2⁶ Peptones, albuminose.

1⁷ Same elements and test as of proteids.

2⁷ Formed in alimentary canal by digestive fluids.

3⁷ Characteristic quality—diffusibility.

4⁷ Differs from proteid in that it can be dialyzed.

3⁶ Albuminoids.

1⁷ Elements found in it—C, H, O, N., rarely S.—

2⁷ Examples.

1⁸ Gelatine.

2⁸ Chondrin.

3⁸ Mucin.

4⁶ Crystalline nitrogenous substances.

1⁷ Principally broken down material.

2⁷ Always contains "ammonium residue."

3⁷ Most important.

1⁸ Urea (Carbamide $\left.\begin{matrix} CO \\ H^2 \\ H^2 \end{matrix}\right\} N^2$

2⁸ Uric acid.

3⁸ Kreatin and kreatinin.

4⁸ Taurocholic and glycocholic acids in bile.

5⁶ Nitrogenous coloring matters.

1⁷ Haematin—one element of haemoglobin.

1⁸ Forms with a proteid residue, haemoglobin.

2⁷ Cruorin—(*Cutter.*)

3⁷ Bilirubin, predominating in human bile and bile of Carnivora.

4⁷ Biliverdin predominating in bile of Herbivora.

2⁵ Non-nitrogenous or non-azotized organic compounds.

1⁶ Hydrocarbons.

1⁷ Elements.—C, H, O.

2⁷ Average amount in man of 165 lbs—6 lbs.
3⁷ Principal ones.
1⁸ Olein—($C^{57}H^{104}O^6$).
2⁸ Stearin—($C^{57}H^{110}O^6$).
3⁸ Palmatin—($C^{51}H^{98}O^6$).
4⁸ Stearin and palmatin solid at Body temperature but change when mixed with olein:
4⁷ Other fats.
1⁸ Margarin.
2⁸ Butyrin.
5⁷ Broken into glycerine and fatty acids by alkalies.
1⁸ Fatty acid joins an alkali to form soap.
2⁸ Oleic, stearic, palmitic, margaritic, and butyric acids.
2⁶ Carbohydrates or amyloids.
1⁷ Elements—C. H. O.
1⁸ Always one atom of oxygen for two of hydrogen.
2⁷ Most important.
1⁸ Glycogen—($C^6H^{10}O^5$).
1⁹ In large quantities in liver—a reserve.
2⁹ In smaller quantities in muscles.
2⁸ Glucose or grape sugar. ($C^6H^{12}O^6$).
1⁹ Found in liver, blood, and lymph.
2⁹ How and where formed?
1¹⁰ Formed by adding water to glycogen. ($C^6H^{10}O^5 + H_2O = C^6H^{12}O^6$).
3⁸ Inosit or muscle sugar ($C^6H^{12}O^6 + 2H^2O$).
1⁹ Found in muscles, liver, spleen, kidneys, etc.
4⁸ Lactose, or sugar of milk.—($C^{12}H^{22}O^{11} + H^2O$).
1⁹ Found in milk.
3⁶ Non-nitrogenous organic acids
1⁷ Carbon dioxide, most important—(CO^2).
1⁸ Nearly all carbon wastes leave the body in this way.
2⁸ Found in bones and teeth with calcium.
2⁷ Butyric, acetic, formic, stearic, palmitic, margaritic and oleic.
3⁷ Lactic—($C^3H^6O^3$).

1^{8} In stomach: develops in milk by souring.

4^{7} Sarcolactic acid. ($C^{13}\ H^{6}\ O^{3}$).

1^{8} Formed in muscles by work and leath.

5^{7} Glycero-phosphoric acid. ($C^{3}\ H^{9}\ PO^{6}$).

1^{8} Formed by decomposition of lecithin.

1. Albuminoid—(Lat.) albumen, and (Gr.) *eidos*, form.
2. Bioplasm—(Gr.) *bios*, life, and *plasma*, formed.
3. Cytogenesis—(Gr.) *kytos*, a cell, and *genesiai*, origin or creation.
4. Carbohydrate, from carbon and hydrate.
5. Endogenous—(Gr.) *endon*, within, and *genesiai*, to be produced.
6. Fissiparous—(Fr.) *fissipare*, from *fissus*, *findere*, to split, and *parere*, to produce,—hence to produce by splitting.
7. Gemmiparous—(Lat.) *gemma*, a bud, and *parere*, to produce.
8. Hydrocarbon from hydrogen and carbon.
9. Intercellular—(Lat.) *inter*, between, and *cellula*, a little cell.
10. Nucleus—(Lat.) *nux*, a nut.
11. Nucleolus, diminutive of nucleus.
12. Protoplasm—(Gr.) *protos*, first, and (Lat.) *plasma*, formed.
13. Proteid—(Gr.) *protos*, first and, *eidos*, form.
14. Peptone—(Gr.) *pepto*, to cook.
15. Sarcolactic—(Gr.) *sarkos*, flesh, and *lac*, milk.

1. Skeleton.

1¹ Hard or supporting parts.
2¹ Materials used in its construction.
1² Bone.
1³ Value of.
1⁴ Main supporting frame work of Body.
2⁴ Determines shade of Body.
3⁴ Provides points for the attachment of muscles and gives levers for movement of Body.
4⁴ Forms cavities and protection for delicate organs.
5⁴ Prevents the weight of organs crushing others below them.
2³ Nature of.
1⁴ Hardest tissue in general.
2⁴ Varies in percentage composition according to age and other conditions.
2 Cartilage.
1³ Uses of.
1⁴ To form elastic pads at joints.
2⁴ In place of bone where great flexibility is needed.
3⁴ Bones in general have been formed from cartilage.
2³ Kinds as to time of lasting.
1⁴ Temporary.
1⁵ Change to bone.
2⁵ Made up of hyaline cartilage.
2⁴ Permanent.
1⁵ Calcification of, in old age.
1⁶ Different from bone in histological character.
3³ Kinds as to structure.
1⁴ Cellular or parenchymatous.
1⁵ Not found in adult.
2⁵ Cartilaginous frame work of ears, of mouse and rat, possess it.
2⁴ Hyaline.
1⁵ Forms cellular but includes more: found in adult.
3⁵ Examples.
1⁶ Encrusting cartilage at articular ends of bone.

2[6] Cartilages of nose.
3[6] Cartilages of windpipe except epiglottis and corniculalaryngis.
3[5] Its purity as a type.
3[4] Fibro-cartilage.
1[5] Kinds.
1[6] White.
1[7] Examples—intervertebral disks and cotyloid ligament.
2[7] Non-elastic.
3[6] Yellow, elastic fibro-cartilage.
4[3] Perichondrium—covering of cartilage.
5[3] A non-vascular tissue in adult.
6[3] Development.—
3[2] Connective tissue proper—secondary.
1[3] Value of.
1[4] Ties bones and cartilages together.
2[4] Keeps together the finer constituents of all organs.
3[1] Subsidiary.
2[3] Where found?
1[4] In all parts of Body.
1[5] Connective tissue alone can give shape to Body. "Skeleton leaf."
3[3] Examples.*
1[4] Ligaments.
2[4] Tendons.
3[4] Membranes, etc.
4[3] Connective tissue corpuscles.—(*Martin 105*).
2[1] Plan—axial and appendicular.
3[1] Kinds as to completeness.
1[2] Natural.
2[2] Artificial.
4[1] Kinds as to position.
1 Exo-skeleton—not very prominent.
1[3] Representative parts in Human Body.
1[4] Hairs.
2[4] Nails.

*Refer to page 10.

3⁴ Hard parts of teeth.
4⁴ Cuticle.
2³ Animals that possess its development prominently.
1⁴ Turtle.
2⁴ Cray-fish or craw-fish.
1⁵ Recurrence of shedding of skeleton.—Why?
2⁵ Shed skeleton often mistaken for real animal.
3⁴ Clam or mussel,
4⁴ Insects as wasps, fly, bee, grasshopper, etc.
3³ Some animals possess neither the endo—or exo-skeleton.
1⁴ Example—earth worm.
4³ Belongs principally to lower forms.
2² Endo-skeleton.
1³ Belongs principally to higher forms.
2³ Advantage of this kind of skeleton.
5¹ Kinds as to material.
1² Connective tissue. "*skeleton leaf.*"
2² Cartilaginous.
3² Bony—osseous system or osteology.*
1³ Principal divisions.
1⁴ Axial.
1⁵ Skull or head.
1⁶ Cranium.
1⁷ Divisions.
1⁸ Occipital.—1.
1⁹ Foramen magnum, for spinal cord.
2⁹ Hypoglossal foramina, for ninth cranial nerves.
3⁹ Condyles for articulation with atlas.
4⁹ Divisions in youth.
1¹⁰ Basilar or basi-occipital in front.
2¹⁰ Condyloid or ex-occipital one on each side.
3¹⁰ Tabular or supra-occipital behind.
1¹¹ Interparietal bone—the upper part—sometimes developed as a separate piece.
1¹² About one case out of a hundred.

*In recitation let the pupil give the location, form, peculiarities and articulation of each bone.

2[8] Parietal.—2.
1[9] Sagittal suture connects them.
3[8] Temporal.—2.
1[9] Parts in youth: somewhat late.
1[10] Petrous portion or petro-mastoid.
1[11] Specially for interal ear.
2[11] Mastoid cells of mastoid process communicate with tympanum.
3[11] Mastoid, rough for attachment of muscles.
4[11] Distinguished for stony hardness.
2[10] Squamoso-zygomatic, or squamous.
1[11] Above and in front of ear.
2[11] Zygomatic process meets the malar.
3[11] Glenoid fossa in lower part of zygomatic for reception of condyle of lower jaw.
3[10] Tympanic.
1[11] Forms wall of external auditory meatus.
2[11] Fuses with squamous.
1[12] Glaserian fissure between them for process of malleus.
4[10] Styloid process.
1[11] Projects downward from tympanic plate.
2[11] Connected to small cornu of hyoid bone by stylo-hyoid ligament.
2[9] Foramens in temporal.
1[10] Stylo-mastoid foramen.
1[11] Nerves of face pass through it.
2[10] Jugular foramen.
1[11] Between petrous-temporal and ex-occipital.
2[11] For eighth cranial nerve and internal jugular vein.
3[10] External auditory meatus.
3[9] Fossae.—
1[10] Glenoid.
2[10] Zygomatic, between squamous and zygomatic.
3[10] Temporal fossae.
4[8] Frontal.—1.

1[9] Supra-ciliary ridge, beneath eyebrow.
2[9] Glabella, elevation at base of nose.
3[9] Air sinuses under glabella and supra-ciliary ridge.
4[9] Wonderful development of glabella and supra-ciliary ridge in Australian.
5[9] Two parts in youth. —
5[8] Sphenoid.—1.
1[9] Divisions in youth.
1[10] Basi-sphenoid.
2[10] Pre-sphenoid.
2[9] Parts.
1[10] Body.
2[10] Wings.
1[11] Greater or ali-sphenoids.—2.
1[12] Forms part of orbit of eye.
2[12] Pair pterygoid processes on each wing.
1[13] Vidian canal at root for vidian nerve.
3[1] Foramina.
1[13] Rotundum for division of fifth cranial nerve.
2[13] Spinosum for artery to brain.
3[13] Ovale for division of fifth cranial nerve.
2[11] Lesser or orbito-sphenoids—2.
1[12] Forms part of orbit—the roof.
2[12] Ends in anterior clinoid process.
3[12] Optic foramen for optic nerve passes through it.
6[8] Ethmoid.—1.
1[9] In front of sphenoid at base of nose.
2[9] Parts, central and lateral.
1[10] Connected by cribriform plates.
2[10] The superior and middle spongy turbinals of lateral.
1[11] Serves to distribute olfactory nerve.
3[10] The os-planum of lateral, in orbit.
3[9] Divisions in youth.
1[10] Basi-ethmoid.
2[10] Pre-ethmoid.

2[7] Sutures.
1[8] Wormian bones or ossa-triquetra.
2[8] Fontanelles.
1[9] Anterior.
1[10] Between two frontal and two parietal.
2[9] Posterior.
1[10] Between two parietal and occipital.
3[9] Lateral.
2[6] Facial skeleton.
1[7] Divisions.
1[8] Malar.—2.
1[9] Helps to complete zygomatic arch.
2[8] Nasal.—2.
1[9] Articulate with frontal and superior maxillae.
3[8] Vomer.—1.
1[9] Articulates with sphenoid, ethmoid, superior maxillae, and palate bones.
4[8] Inferior maxillary or lower mandible.
1[9] Only movable bone of head.
2[9] Processes.
1[10] Anterior or coronoid.
2[10] Posterior or condyle.
1[11] For articulation with glenoid fossa.
3[10] Sigmoid notch between them.
3[9] Alveolar processes and aveoli.
4[9] Divisions in youth.
1[10] Right and left: united first year.
5[9] Characteristic, forward slope: different from other mammals.
6[9] Shape as of a horse-shoe.
7[9] Mental foramen, anteriorly on each side for mental arteries.
5[8] Palatal.—2.
1[9] Shape of capital letter L.
6[8] Inferior turbinated.—2.
1[9] Forms part of outer wall of nose.
7[8] Lachrymal.—2.

8[8] Superior maxillary.—2.
1[9] Help form nose, mouth, and orbit.
2[9] Sort of central bone for face.
3[9] Infra-orbital foramen on facial side for transmission of infra-orbital branch of fifth cranial nerve.
4[9] Orbital part has groove for infra-orbital branch of nerve.
5[9] Antrum or superior maxillary air-sinus in substance of bone.
1[10] Opening leading to it from nose.
6[9] Incisive foramen, roof of mouth behind incisor teeth.
1[10] Very large in sheep.
7[9] Alveolar processes and alveoli.
3[6] Ear bones.
1[7] Mallens or hammer. 1x2.
2[7] Incus or anvil. 1x2.
3[7] Stapes or stirrup. 1x2.
4[7] Os orbiculare in youth. 1x2.
4[6] Os hyoides or hyoid.
1[7] Shape—a letter U.
2[7] Parts.
1[8] Body or basi-hyal.
2[8] Pairs cornua.
1[9] Large cornua, stylo-hyals.
2[9] Small cornua, cerato-hyals.
1[10] Connected to styloid process by stylo-hyoid ligament: epi-hyals.
3[7] Above "Adam's apple."
4[7] Probably a remnant of gills. (*See Martin.*)
5[6] Characteristics of skull.
1[7] Form, ovoid. 7 in. by 5½ in. by 5¼ in.
1[8] Longer, antero-posteriorly.
1[9] Articulates with superior maxillary, ethmoid, and frontal bones.
2[9] Lachrymal groove for lachrymal sac.
3[9] Shape of a finger nail—scale like.

2^{8} Lateral regions possess.
1^{9} Zygomatic fossae.
2^{9} Temporal fossae.
3^{9} Spheno-maxillary fossae.
4^{9} External auditory meatus.
3^{8} Front possesses.
1^{9} Nasal fossae.
2^{9} Orbital fossae, for eye.
3^{9} Mouth.—
2^{7} Differences in sex.
1^{8} Female skull smaller and lighter.
2^{8} Female skull more infantile.
3^{7} Capacity of cranium about 92 cu. in. in male, and 83-4 cu. in. in female.
4^{7} Circumference, 21 in. more or less.
2^{5} Trunk.
1^{6} Spinal column, spine, vertebral column, chine, or back-bone.
1^{7} Vertebrae.
1^{8} True.
1^{9} Cervical.—
1^{10} First, atlas.*
1^{11} Odontoid foramen.
2^{11} Transverse ligament divides neural cavity from odontoid foramen.
3^{11} Fossae for occipital condyles.
4^{11} Possesses no body or spine.
2^{10} Second, axis or *vertebra-dentata*.
1^{11} Odontoid process and its purpose.
1^{12} Supposed to be part of body of atlas.
3^{10} Vertebra prominens, seventh.
1^{11} Distinguished by long prominent spine and small foramen at root.—
4^{10} Always seven in number in man.
1^{11} Three toed sloth has nine vertebrae.

*One often can secure illustrations of this and other bones for class use. The author for a long time used in his class the atlas and axis of a lower animal, the odontoid process and transverse ligament remaining intact.

2^{13} Hoffman's sloth and manatee have but six.
5^{10} In cervical vertebrae of man foramina are in bone at root of transverse processes.
2^{9} Dorsal, costal, or thoracic.—12.
1^{10} Range in number among mammals from eleven in armadillo to twenty-two in the cape hyrax and Hoffman's sloth.
3^{9} Lumbar.—5.
1^{16} Varies in number among mammals. 2 to 8.
2^{8} False.
1^{9} Sacrum.—5 in youth.
1^{16} Anterior sacral foramina four pairs.
2^{16} Posterior sacral foramina four pairs.
3^{10} Parts ankylose into one bone.
4^{16} Broader proportionately to its length than in other mammals.
5^{10} Form—triangular.
2^{9} Coccyx—4 in youth.
1^{10} Last bone—coccygeal.
2^{10} Parts ankylose.
3^{16} Curved forward instead of backwards.
3^{8} Intervertebral disks or ligaments.
1^{9} Value of—.
1^{16} To prevent jars and sharp bends.
2^{10} To permit a bending of trunk.
4^{8} Intervertebral foramina.
1^{9} Purpose, for passage of nerves.
5^{7} Structure.
1^{7} Body or centrum.
2^{9} Neural arch.
3^{9} Neural ring.
4^{9} Laminae.
5^{9} Pedicle.
6^{9} Processes.—7.
1^{10} Spinous.—1.
2^{16} Anterior articular.—2.
3^{10} Posterior articular.—2.
4^{10} Transverse. —2.

5[10] Purpose.
6[8] Vertebral formula.
1[9] C^{7} D^{12} L^{5} S^{5} Coc^{4}.
2[7] Curvatures of spine—four.
1[8] Value of.
1[9] To prevent shocks.
2[9] To produce best movement.
3[9] For strength.
4[9] For elasticity.
2[8] Cervical, dorsal, lumbar, and sacro-coccygeal.
2[6] Ribs—costae.
1[7] Classes.*
1[8] Vertebro-sterno, sternal, or true.—7x2.
2[8] Vertebro-costal, a-sternal, or false.—3x2.
3[8] Vertebral, floating.—2x2.
2[7] Costal cartilages.
3[7] Curvatures.
3[6] Sternum—in adult.
1[7] Manubrium—prae-sternum.
2[7] Gladiolus—meso-sternum.
3[7] Xiphoid or ensiform appendage—xiphi-sternum.
4[6] Cavities formed.
1[7] Thorax, pectus, or chest.
2[7] Abdomen.
5[6] Bone in heart of beef but not in the heart of man.
2[4] Appendicular.
1[5] Upper extremities.—64.
1[6] Shoulder girdle, pectoral, or scapular arch.
1[7] Clavicle. 2x2.
1[8] Ends.
1[9] Sternal—thick and somewhat triangular.
2[9] Acromial.
2[8] Absent in hoofed quadrupeds, seals, whales and feeble in carnivora.
3[8] Most often broken of bones.

*The first names are the best because the names give within themselves the articulations.

2^{7} Scapula. 1x2.
1^{8} Subscapular fossa—ventral aspect.
2^{8} Spine—dorsal aspect.
1^{9} Supra, or *prae-spinous* fossa above spine.
2^{9} Infra, or *post-spinous* fossa below spine.
3^{8} Acromion process—continuation of spine.
4^{8} Coracoid process—curved beak over glenoid fossa.
5^{8} Glenoid fossa.
1^{9} For articulation with head of humerus.
2^{6} Fore limb—arm—upper limb.
1^{7} Bones.
1^{8} Humerus. 1x2.
1^{9} Parts of this and every long bone.
1^{15} Shaft.
2^{10} Articular extremities.
2^{9} Tuberosities at upper head—trochanters.—2.
1^{10} Greater and lesser.
3^{9} Other distinctive parts.
1^{10} Condyles, below—internal and external.
2^{15} Supra-condyloid foramen.
3^{15} Ridges for muscles.
4^{15} Capitellum for radius.
2^{8} Radius—thumb side. 1x2.
1^{9} Resembling a spoke—upper part.
2^{9} Styloid process—lower, outer.—
3^{9} Pronation and supination possible.
3^{8} Ulna, cubit. 1x2.
1^{9} Olecranon process—at elbow.
2^{9} Styloid process—outer, little finger side.
3^{9} Greater sigmoid cavity.
1^{10} Humerus fits in it.
4^{9} Lesser sigmoid cavity.
1^{10} For articlation with lower radius.
4^{8} Carpal. 8x2. *
1^{9} Proximal row.

*S. S. C. P is proximal row beginning on thumb side. T. T. O. U. is distal row beginning on thumb side.

1[10] Scaphoid—S.
2[10] Semilunar—S.
3[10] Cuneiform—C.
4[10] Pisiform—P.
2[9] Distal row.
1[10] Trapezium—T.
2[10] Trapezoid—T.
3[10] Osmagum—O.
4[10] Unciform—U.
3[9] Possibility of supernumary bone, being formed by division of one of others.
5[8] Metacarpal. 5x2.
6[8] Digits—5.
1[9] Phalanges. 14x2.
1[10] Proximal, middle, and ungual.
2[9] Pollex or thumb, index, middle, ring, and little fingers.
2[5] Lower extremities. 62.
1[6] Pelvic girdle, haunches.
1[7] Bones of.—
1[8] Os innominata or innominate, haunch bones.
1[9] Divisions until about 25th year.
1[10] Ilium—upper part.
1[11] Connected to sacrum behind.
2[10] Ischium—lower dorsal part.
3[10] Pubis—lower ventral part.
1[11] *Pubic symphysis*—meeting of pubic bones.
2[11] Pectineal eminence at junction with ilium.
2[9] Acetabulum or cotyloid cavity.
1[10] Formed by three innominates.
2[10] Round and capsular ligaments.
3[10] For head of femur.
3[9] Thyroid or obturator foramen.
1[10] Largest foramen in Body.
2[10] Formed by ischium and pubis.
2[6] Hind or lower limbs.
1[7] Thigh.

1[8] Femur. 1x2.
1[9] Round ligament on head.
2[9] Trochanters.
1[10] Internal.
2[10] External.
3[9] Trochlea—lower anterior portion for patella.
4[9] Condyles, two, posterior aspect.
5[9] Longest bone of Body.—
2[7] Leg.—
1[8] Patella.
1[9] Probably a sesamoid bone.
2[8] Tibia, shin bone.—anterior aspect. 1x2.
1[9] Two tuberosities above.
2[9] Second longest bone of Body.
3[9] Internal malleolus—inner ankle.
3[8] Fibula—splint bone. 1x2.
1[9] External malleolus—outer ankle.
2[9] Relative strength of, to tibia.
3[7] Foot.—
1[8] Tarsal. 7x2.
1[9] Proximal row to tibia.
1[10] Os calcis or calcaneum, heel—O.
1[11] Largest.
2[10] Astragalus—A.
3[10] Scaphoid.—S.
2[9] Distal row to tibia, proximal to metatarsal.
1[10] Cuboid—C.
2[10] Ecto-cuneiform—C.
3[10] Meso-cuneiform—C.
4[10] Ento-cuneiform—C.
3[9] Supernumary possible by division of ento-cuneiform, astragalus, os calcis, or cuboid.
2[8] Metatarsal. 5x2.
3[8] Digits. 5x2.
1[9] Phalanges. 14x2.
3[5] Homology or comparison of appendicular divisions.
1[6] Pelvic girdle corresponds to pectoral arch.
2[6] Humerus corresponds to femur.

3[6] Radius and ulna correspond to tibia and fibula.
4[6] Olecranon process corresponds to patella.
5[6] Eight carpals correspond to seven tarsals, some tarsal being divided originally.
6[6] Elbow joint bends ventrally, the knee joint dorsally.
7[6] Greater movement of upper extremities than of lower extremities.
1[7] Shallow socket for head of humerus.
2[7] "Shrugging of shoulders."
1[8] Why possible?
3[7] Immovable attachment of pelvis to sacrum.
8[6] Metacarpals correspond to metatarsals.
9[6] Phalanges of hand correspond to phalanges of feet.
2[3] Sesamoid bones.
1[4] Found principally at joints of toes and thumbs.
2[4] Formed by continued hard pressure.
1[5] Pressure may be produced by tendon.
3[4] Principally in persons of muscular habit.
6[1] Peculiarities of human skeleton.
1[2] Skull nearly balanced on vertebral column.
1[3] Little effort needed to maintain erect position.
2[3] Most nearly balanced in man.
3[3] Monkey's facial part heavier.
4[3] Four-footed beasts need a special ligament.
2[2] Of spinal column.
1[3] Gradual widening from top to bottom.
1[4] Well fitted to sustain additional weight.
2[3] Its curvatures giving greater elasticity to spine and protection to delicate organs, located in dorsal and ventral cavities.
3[3] Offices performed by it.
1[4] To support the head.
2[4] To furnish an axis of support for other parts of the Body.
3[4] To allow a bending and somewhat rotary motion.
4[4] To furnish a basis for the attachment of muscles.
5[4] To provide a passage and protection to the spinal cord and nerves.

6^4 Well constructed for the importance and delicacy of the brain.

3^2 Great movement of the shoulder and divisions of upper limbs.

1^3 Adaptation of prehensile organs and their parts to their use, especially the thumb.

4^2 Pelvis broad, preventing an easy upsetting.

5^2 Lower limbs proportionately long.

1^3 Prevents going on all fours.

2^3 Rapid progression possible.

3^3 Arched instep giving elasticity to jar.

1^4 Flat-footed candidates for policemen not accepted in London.—Cannot bear fatigue.

2^4 Value of tarsal bones.

4^4 Broad foot giving great range for balance of gravity.—

5^4 Man, bear, and ape plantigrade, while some animals walk on tips of toes.

NOTES.

1. Ankylose—Gr., *ankyloyn*, to stiffen.
2. Abdomen—Lat., *abdere*, to hide, and *omentum*, entrails.
3. Acromion—Gr., *akros*, extreme, and *omos*, shoulder.
4. Acetabulum—Lat., *acetum*, vinegar, from resemblance to vinegar cup.
5. Astragalus—Lat., ankle bone.
6. Alveolar—Lat., *alveolus*, a small hollow.
7. Cervical—Lat., *cervix*, the neck.
8. Condyle—Gr., *kondos*, head or knob.
9. Coronoid—Gr., *korone*, a crown, and *eidos*, form.
10. Cornua—Lat., *cornu*, a horn.
11. Coccyx—Lat., a cuckoo, because of resemblance.
12. Clavicle—Lat., *claris*, a key.
13. Coracoid—Gr., *korax*, a crow, and *eidos*, form; named so because of resemblance to crow's beak.
14. Capitellum—Lat., diminutive of *caput*, meaning a small head.
15. Carpal—Lat., *carpus*, the wrist.
16. Cuneiform—Lat., *cuneus*, a wedge.
17. Costal—Lat., *costa*, a rib.
18. Cuboid—Gr., *kubos*, a cube, and *eidos*, form.
19. Cotyloid—Gr., *kotyle*, a receptive cavity, and *eidos*, form; receives head of femur.
20. Calcaneum—Lat., *calx*, the heel
21. Dorsal—Lat., *dorsum*, the back.
22. Endo skeleton—Gr., *endon*, within, and skeleton
23. Exo skeleton—Gr., *exo*, outside, and skeleton.
24. Ethmoid—Gr., *ethmos*, a sieve, and *eidos*, form.

25. Fontanelle—Fr., diminutive, of *fontaine*, fountain, meaning a little fountain, so named because of its bubbling.
26. Fibula—Lat., *figere*, to fasten.
27. Glenoid—Gr., *glene* a cavity, and *eidos*, form.
28. Gladiolus—Lat., diminutive of *gladius*, a sword.
29. Hyaline—Gr., *hyalos*, glass, so called because of its glassy appearance.
30. Hypoglossal—Gr., *hypo*, under, and *glossa*, tongue, so named because of hypoglossal nerve that passes through its opening.
31. Humerus—Lat., the arm bone.
32. Hyoid—Gr., *y*, the Greek letter ups lon, and *eidos*, form: so named because of resemblance.
33. Intervertebral—Lat., *inter*, between, and vertebra.
34. Innominate—Lat., *in*, not, and *nominare*, to name.
35. Ilium—Lat., *ilia*, the groin.
36. Ischium—Gr., *ischion*, the hip.
37. Lachrymal—Lat., *lacryma*, a tear.
38. Ligament—Lat., *ligare*, to bind.
39. Lumbar—Lat., *lumbus*, the loin.
40. Lamina—Lat., a thin plate.
41. Mastoid—Gr., *mastos*, the breast of a woman, and *eidos*, form.
42. Malleus—Lat., a hammer.
43. Malleolus—Lat., diminutive of malleus.
44. Malar—Lat., *mala*, the cheek.
45. Maxillary—Lat., *maxilla*, the jaw bone diminutive of mala.
46. Manubrium—Lat., a handle, from *manus*, the hand.
47. Metacarpal—Gr., *meta*, beyond, and *karpos*, the wrist.
48. Metatarsal—Gr., *meta*, beyond, and *tarsos*, the flat of the foot.
49. Nasal—Lat., *nasus*, the nose.
50. Occipital—Lat., *ob*, from, and *caput*, the head.
51. Odontoid—Gr., *odons* or *odontos*, a tooth, and *eidos*, form.
52. Olecranon—Gr., *olene*, elbow, and *kranon*, the head.
53. Os-magnum—Lat., *os*, a bone, and *magnum*, large.
54. Obturator—Lat., *obturare*, to stop up: closed by membranous ligament in life.
55. Os-calcis—Lat., *os*, a bone, and *calx*, the heel.
56. Parietal—Lat., *paries*, a wall, so called because they defend the brain like walls.
57. Petrous—Lat., *petra*, a stone, because of hardness.
58. Pisiform—Lat., *pisum*, a pea, and *forma*, form.
59. Phalanges—Lat., *phalanx*, a division of finger bones.
60. Pubis—Lat., the anterior part of the innominate bones.
61. Patella—Lat., diminutive of *patina*, a pan or dish.
62. Radius—Lat., a spoke of a wheel, so named because of resemblance to a spoke.
63. Skeleton—Lat., *skellein*, to dry up.
64. Squamous—Lat., *squama*, a scale.
65. Styloid—Gr., *stylos*, a style, and *eidos*, form.
66. Supra-ciliary—Lat., *supra*, above, and *cilia*, the eyelashes.
67. Sphenoid—Gr., *sphen*, a wedge, and *eidos*, likeness.
68. Suture—Lat., *suere*, to sew or stitch.
69. Sacrum—Lat., meaning sacred.

70. Sternum--Gr., *sternon*, the breast or chest.
71. Scapula--Lat., the shoulder blade.
72. Sigmoid--Gr., *sigma*, a Greek letter, and *eidos*, form; so named because of resemblance.
73. Scaphoid--Gr., *skaphos*, a boat, and *eidos*, form.
74. Semilunar--Lat., *semi*, half, and *luna*, the moon.
75. Symphysis--Gr., *syn*, with, and *phyein*, to grow.
76. Sesamoid—Gr., *sesamon*, a plant seed, and *eidos*, form.
77. Scaphoid—Gr., *skaphos*, a boat, and *eidos*, form.
78. Temporal—Lat., *tempora*, the temple.
79. Tympanum—Lat., a kettle drum, so called because of resemblance.
80. Turbinated—Lat., *turbo*, a top.
81. Trapezium—Gr., *trapezion*, diminutive of *trapeza*, a table.
82. Trapezoid—Gr., *trapeza*, a table, and *eidos*, form.
83. Thyroid—Gr., *thyreos*, a shield.
84. Trochanter.Gr., a runner.
85. Trachea—Gr., *trachus*, rough and rugged.
86. Tibia—Lat., the shin bone.
87. Tarsal—Lat., *tarsus*, the posterior part of the foot.
88. Tendon—Lat., *tendere*, to stretch or extend.
89. Ulna—Lat., *ulna*, the elbow.
90. Unciform—Lat., *uncus*, a hook, and *forma*, form.
91. Vomer—Lat., a plowshare.
92. Vertebra—Lat., *vertere*, to turn.
93. Xiphoid—Gr., *xiphos*, a sword, and *eidos*, form.
94. Zygomatic—Gr., *zygoma*, the cheek-bone.

1. Bone.

1[1] Structure.

1 Gross structure.

1[3] Classes of bone.

1[4] As to length.

1[5] Long.

1[6] Divisions of long bones.

1[7] Shaft.

2[7] Articular extremities.

3[7] Growth in length principally between articular extremities and shaft, at cartilage.

2[5] Short.

2[4] As to diametrical shape.

1[5] Tabular.

2[5] Round.

3[5] Irregular.

2[3] External structure.

1[4] Diaphysis—the main part of a long bone.

2[4] Epiphysis—a portion which was developed as a separate piece but afterwards united.

3[4] Apophysis—a prominent projection but never separated.

4[4] Eminences.*

1[5] Tuberosities—broad, uneven elevations.

2[5] Tubercles—small rough projections.

3[5] Spines—sharp slender projections.

4[5] Ridges or lines—narrow, rough, extended elevations.

5[4] Depressions.

1[5] Fossæ, grooves, and fissures.

6[4] Purposes of eminences and depressions.

1[5] Gives larger surface for attachment of muscles.

2[5] Gives greater strength with the same amount of material.

7[4] Covering—periosteum.

1[5] Its value.

1[6] Serves for passage of nerves and blood-vessels.

2[6] Serves for attachment of muscles.

*For trochanters and condyles, see previous outline.

3^6 Growth of bones in diameter by deposit of bone cells under it.—osteoblasts.
4^6 Bone dies if periosteum be stripped off.
1^7 Felon.—How cured?
2^5 End covering—gristle or articular cartilage.
1^6 All bones as a rule were formed from cartilage.
3^3 Internal structure, by cross sections.
1^4 Compact portion.
1^5 Very few and very small cavities.
2^5 Perforating fibers.
3^5 Nerves.
4^5 Blood-vessels and lymph vessels.
2^4 Spongy portion, cancellated.
1^5 Red marrow located in spaces.
1^6 Supposed origin of red corpuscles of blood here.—
2^5 Diploe in flat bones.
3^4 Hollow or medullary cavity.
1^5 For marrow.
1^6 Myeloid cells of Kolliker and Robin in it.
2^5 For air.
3^5 For lightness.
4^5 For strength.
5^5 For large surface, in attachments of muscles.
6^5 Endosteum, lining it; internal periosteum. Doubtful.
2^2 Microscopic or histological.
1^3 Haversian systems in it.
1^4 Haversian canals.
1^5 Average diameter, about $\frac{1}{500}$ inch.
2^5 Lamellae—bony plate surrounding canals.
1^6 Lacunae, between them.* (*Martin.*)
1^7 Lenticular in shape.
2^7 Osteoblasts, or bone cells in them.
3^7 Average length $\frac{1}{1250}$ to $\frac{1}{800}$ inch.
2^6 Canaliculi in them, connecting lacunae with lacunae or with Haversian canals.
1^7 Average length $\frac{1}{800}$ to $\frac{1}{600}$ inch.

*Also called osteoplasts by Flint.

2^{7} Diameter about $\frac{1}{2500}$ inch.
3^{7} Bone cell prolongations sent into them.
3^{6} General direction, longitudinal.
4^{6} Nucleated cells or osteoblasts extend into them.
5^{6} Principally found in the compact or bony structure, very few in spony or reticulated part.
2^{4} Circulation of bone carried on through it.
2^{3} Laminae.
3^{3} Perforating fibers. (*Sharpey*).
4^{3} Haversian spaces. (*Britanica*).
5^{3} Medullary spaces.
6^{3} Cancellated spaces.
7^{3} Medullo cells in marrow, especially in old bones. (*Flint*).
1^{4} Diametef $\frac{1}{5000}$ to $\frac{1}{3500}$ inch.
8^{3} Myeloplaxes. (*Flint*).
1^{4} In marrow.
2^{4} Diameter $\frac{1}{1200}$ to $\frac{1}{250}$ inch.
2^{1} General properties or characteristics of bone.
1^{2} Hardness.
2^{2} Color—bluish-white in life. Why?
1^{3} Varies some in age.
3^{2} Elasticity and flexibility to a great extent.
1^{3} Varies according to age, etc.
1^{4} Why? Because of chemical composition.
4^{2} Weight.
3^{1} Chemical composition.
1^{2} Kinds of substances.
1^{3} Organic and inorganic or mineral.
1^{2} Varies in proportion.
1^{5} In different bones.
2^{5} With age.
3^{5} With certain diseased conditions—*rickets*: not generally later than the twelfth year.
2^{4} How extract either separate from the other?
1^{5} Use of acids to extract mineral.
1^{6} Tying of bones in a knot.
2^{5} Calcine in a clear flame to extract animal.

3⁴ Usual composition. (*Berzelius*).

1⁵ Organic.

1⁶ Gelatine, blood-vessels, etc. 33.3 per ct.

2⁵ Inorganic or mineral. 66.7 per ct.

1⁶ Calcium phosphate, 51.04 per ct.

2⁶ Calcium carbonate, 11.30 per ct.

3⁶ Calcium fluoride, 2.00 per ct.

4⁶ Magnesium phosphate, 1.16 per ct.

5⁶ Soda and sodium chloride, 1.20 per ct.

4⁴ Bone black.

1⁵ How made?

2⁵ For what used?

1⁶ As a decolorizer, and as a black pigment.

4¹ Bone development.

1² Varies in number of centers—long bones three.

2 Modes. (*Cutter*).

1³ Intramembranous.

1⁴ Principally in flat bone formation.

2³ Intracartilaginous.

1⁴ Ordinary method—cartilage cells give way to bone cells.

5¹ Hygiene of bones.

1² Young bone is very flexible: great per cent of animal matter.

1³ Avoid high seats.

2³ Avoid too early walking.

1⁴ Bandy or bow legs.

3³ Avoid any unnatural position, tending to distort.

4³ Importance of correct positions in youth.

1⁴ Curvature of spine.

5³ Food containing phosphate of lime necessary.

1⁴ Arrow root deficient.

2⁴ Milk in proper quantity the best.

2² Old bone has small animal matter.

1³ Easily broken. Cases are recorded of fractures by mere muscular contraction, such as turning over in bed.

2³ Care of fractures at this age.

3² Fractures.

1³ How treat?

2^3 Use of splints.

3^3 Repair takes place by deposit of bone cells.

4^2 Straightening of bones by removing piece and leaving periosteum intact.—

NOTES.—

1. Apophysis—Gr., *apo*, from, and *phyein*, to grow.
2. Canaliculi—diminutive of canal.
3. Diaphysis—Gr., *dia*, through, and *phyein*, to grow.
4. Diploe—Gr., *diploos*, twofold or double.
5. Epiphysis—Gr., *epi*, upon, and *phyein*, to grow.
6. Fossa—Lat., *fodere*, to dig.
7. Intra-membranous—Lat., *intra*, within, and membrane.
8. Intra-cartilaginous—Lat., *intra*, within, and cartilage.
9. Lamella—Lat., diminutive of lamina, a plate.
10. Medulla—Lat., *medius*, the middle.
11. Osteoblast—Gr., *osteon*, a bone, and *blastos*, a germ.
12. Periosteum—Gr., *peri*, around, and *osteon*, a bone.

1. Articulations.

1[1] Uses.

1[2] Body sustains greater weight because of short pieces instead of one long one.

2[2] It makes movement possible.

3 Diminishes force of blows or shocks.

4[2] Determines plane of action and direction of muscular power.—

2[1] Kinds.

1[2] Synarthrosis—immovable.

1[3] Sutura—interlocked like dove-tailing.

1[4] In cranial bones.

1[5] Coronal suture between frontal and parietal.

1[6] Anterior fontanelle at junction with sagittal.

2[5] Lambdoidal suture between parietal and occipital.

1[6] Posterior fontanelles at junction with sagittal.

3[5] Sagittal suture between parietals.

2[4] Between superior maxillae.

2[3] Schindelysis, a thin plate of bone fitting into a fissure in another,—vomer into sphenoid.

3[3] Gomphosis, conical processes into another—teeth into alveolar sockets.

2[2] Amphiarthrosis or mixed—symphysis.

1[3] Between divisions of vertebral column, parts of sternum and their connection to ribs, also between pubic bones.

3[2] Diarthrosis, movable or joints. (*Martin*).

1[3] Of what use?—

1[4] Same as uses of articulations.

2[3] End of bone covered by articular cartilage.

1[4] Deadens shocks.

2[4] Facilitates movement of bones over each other.

3[4] Synovial membrane covering articular cartilage.

1[5] Secretes synovial fluid.—

2[5] Inflammations, caused by sprains, rheumatism, etc., tend to destroy it.

1[6] A growing together of bones at joints.

2[6] Dislocations should be treated as soon as possible.

1[7] Ligaments more or less torn.

3[5] Kinds. (*Cutter*).

1[6] Bursae Mucosae.

1[7] Pouches inserted between bones.

2[6] Sub-cutaneous Synovial Capsules.

1[7] Between skin and resisting part, as between skin and patella.

3[6] Articular Capsule.

1[7] One complete sac, covering articular surface of one bone and reflected to other, covers that surface also.

3[3] Ligaments.

1[4] Capsular.

1[5] Extends around joint and blends with periosteum.

2[4] Band-like.

1[5] With hinge joint and sometimes accessory to capsular.

3[4] Funicular or round.

1[5] A kind of continuation of periosteum.

2[5] Best example in hip joint.

4[3] Kinds of joints.

1[4] Ball and socket.

1[5] Examples.

1[6] Hip joints.

1[7] Round ligament.

2[7] Capsular ligament.

3[7] Acetabulum or cotyloid cavity.

4[7] Not easily displaced. Why?

2[6] Shoulder joint.

1[7] Range of movement. Why?

2[7] How formed?

3[7] Glenoid fossa.

3[6] Between carpal bone and metacarpal bone of thumb.

4[6] Between matacarpal and proximal phalanx of finger.

2[4] Hinge joints.

1[5] Examples.

1[6] Between phalanges.
2[6] Knee joints.
3[6] Lower jaw and glenoid fossa of temporal.
3[4] Pivot joints.
1[5] Examples.
1[6] Atlas and axis vertebrae.
1[7] Odontoid process.
2[7] Transverse ligament.
2[6] Movement of forearm.
1[7] Pronation.
2[7] Supination.
4[4] Gliding joints.
1[5] Between carpal bones.
2[5] Between tarsal bones.

NOTES.—

1. Articulation—Lat., *articulatio*, the joining or juncture of bones of a skeleton.
2. Amphiarthrosis—Gr., *amphi*, around or on both sides of, and *arthron*, a joint.
3. Acetabulum—Lat., *acetum*, vinegar, from its resemblance to a vinegar cup.—
4. Bursae Mucosae—Lat., *bursa*, an exchange, *mucus*, a viscid fluid.
5. Cotyloid—Gr., *kotyle*, a cavity of a bone which receives the end of another bone in articulation, and *eidos*, form.
6. Diarthrosis—Gr., *dia*, through, and *arthron*, a joint.
7. Gomphosis—Gr., *gomphos*, bolt or nail, because of their reception by another.
8. Glenoid—Gr., *glene*, a cavity, and *eidos*, form.
9. Ligament—Lat., *ligare*, to bind.
10. Odontoid—Lat., *odontos*, a tooth, and Gr., *eidos*, form.
11. Pronation—Lat., *pronare*, to bend forward.
12. Synarthrosis—Gr., *syn*, with, and *arthron*, a joint.
13. Sutura—Lat., *suere*, to sew.
14. Synovia—Gr., *syn*, with, and Lat., *ovum*, an egg.
15. Sub-cutaneous—Lat., *sub*, under, and *cutis*, the skin.
16. Supination—Lat., *supinare*, to bend or lay backward.

1. Motor organs.

1[1] Distinction between dead and living matter.

2[1] Motion in animals and plants.

1[2] Of plants.

1[3] Closing of flower in the evening and opening in the morning.

2[3] Venus's fly-trap imprisons insect if hair on surface of leaf be touched.

3[3] Lack of this power in higher plants.

2[2] Of animals.

1[3] Possess.

1[4] Organs of vegetative life, i. e., for the higher forms of animal life.

2[4] Organs of relation or of animal life.

1[5] Nervous organs.

2[5] Muscular organs.

3[1] Simplest forms.

1[2] Amœboid cells.

1[3] Slightly modified, undifferentiated form.

2[3] Hardly motor, but might be called undifferentiated.

2[2] Ciliated cells.

1[3] Cilia.

1[4] Found in windpipe.

2[4] Value in moving substances in one direction.

1[5] "Hawking" up of phlegm.

4[1] Main organs.

1[2] Muscles.

1[3] Number 500 plus.

2[3] Size.

1[4] In length, varies from 1 to 18 inches.

2[4] In thickness, varies much.

3[3] Functions.

1[4] Primary, to move the Body.

2[4] Secondary.

1[5] Gives roundness and shape to the Body.

2[5] Aids in enclosing cavities.

3[5] Helps in holding joints together.

4[5] As a protector to delicate organs.
5[5] Serves as a medium for blood and lymph distribution.
4[3] Parts.
1[4] Belly, working part—elastic.
2[4] Tendons, inelastic.
1[5] Aponeuroses or fasciae closely related.
1[6] Flat in form while tendon is more round like.
2[6] Seems to have a function between that of tendons and of ligaments.
2[5] Length often very great, comparatively.
3[5] Necessity of tendons.
1[6] For purposes of best movement.
1[7] Prevents clumsiness by keeping mass from joints.
2[7] Inelasticity of tendons gives a fixed character to the contractions of muscles.
4[5] Glue a product of tendon and ligament.
5[3] Points in description of muscle.
1[4] Ends, or points of attachment.
1[5] Origin.
1[6] Least movable part in natural condition.
1[7] "Hand over hand" movements in going up a rope, origin at movable part..
2[5] Insertion.
1[6] End where greatest movement ordinarily takes place.
2[4] Relations to other parts.
3[4] Actions and uses.
4[4] Size and shape.
6[3] Kinds of muscles.
1[4] As to shape.
1[5] Penniform, feather-like.
1[6] Belly on one side of tendon.
2[6] Example.—*Peroneus longus.*
2[5] Bipenniform, feather-like.
1[6] Belly on both sides of central tendon.
2[6] Example.—*Rectus femoris.*
3[5] Tripenniform. *Diaphragm.*
1[6] Example.

4⁵ Digastric.
1⁶ Tendons in center, diametrically, and at ends.
2⁶ Examples. *Trochlear* of eye, and *Digastric* of lower jaw.
3⁶ Generally a pulley.
5⁵ Polygastric.
1⁶ Several bellies separated by tendons.
2⁶ Example. *Rectus Abdominis* of front of abdomen.
6⁵ Spindle shaped or fusiform.
1⁶ Example. *Stylo-hyoid.*
7⁵ Radiate.
1⁶ Example. Temporal.
8⁵ Orbicularis or sphincter.
1⁶ Sphincter at pyloric opening.
2⁴ As to mode of action.
1⁵ Extensors, those which straighten a part from a bent position.
2⁵ Flexors, the opposite of extensors.
3⁵ Abductors, those which move a limb from the body.
4⁵ Adductors, opposite of abductors.
5⁵ Pronators, rolls a part on its face.
6⁵ Supinators, opposite of pronators.
7⁵ Sphincter, those which act like a draw string to close an opening.
3⁴ As to position.
1⁵ Superficial, near the surface.
2⁵ Deep seated, near the bone.
4⁴ As to volition.
1⁵ Voluntary.
1⁶ Generally striated fibers.
2⁵ Involuntary.
1⁶ More or less non-striated.
1⁷ Heart, striated.
1⁸ Has been known to be stopped by will.
5⁴ As to structure.
1⁵ Skeletal or striated.
2⁵ Visceral or non-striated.

7[3] Structure of muscle.
1[4] General or gross.
1[5] Covering of entire muscle.
1[6] External perimysium.
2[5] Fasciculi, parts of muscle, bundles.
1[6] Coarseness or fineness of meat depends on their size.
2[6] Covering, perimysium.
3[6] Connective tissue separates larger fasciculi.
1[7] Internal perimysium.
4[6] True muscular substance within only.
1[7] Not penetrated by blood vessels, lymphatics, or nerves.
5[6] Comparatively small in children or in persons of slight muscular development.
1[7] Diameter in young persons, $\frac{1}{1700}$ to $\frac{1}{1200}$ inch.
2[7] Diameter in adult, $\frac{1}{450}$ to $\frac{1}{250}$ inch.
3[5] Blood vessels, nerves, and lymphatics scattered through the muscles.
2[4] Special or histological.
1[5] Fibers.
1[6] Length, about $\frac{1}{3}$ to $1\frac{1}{2}$ inches.
2[6] Diameter, $\frac{1}{750}$ to $\frac{1}{150}$ inch.
3[6] Covering, sarcolemma, or myolemma.
1[7] Changes into sarcolactic acid by work and death.
2[7] True muscular tissue found within it.
3[7] Cardiac muscles are said not to possess it.
4[6] Divisions, fibrillae.
8[3] Physiological properties of muscle.
1[4] Elasticity.
1[5] Specially possessed by sarcolemma.
2[4] Tonicity, a constant and insensible tendency to contraction.
3[4] Sensibility of peculiar kind—muscular sense.
1[5] Such as fatigue, appreciation of weight and resistance to contraction.
4[4] Contractility or irritability.
1[5] Produced by proper stimulus.

5⁴ Faculty of generating galvanic currents. (*Matteucci*).
1⁵ Nurses should follow current in rubbing, otherwise irritation is produced.
9³ Chemical composition of muscle.
1⁴ Inorganic substances.
1⁵ 75 per cent of water.
2⁵ Phosphates.
3⁵ Chlorides of potassium, sodium, and magnesium.
2⁴ Organic substances.
1⁵ Inogen, the main contractile part.
1⁶ A hypothetical substance.
2⁶ Composed of.
1⁷ Carbohydrates.
2⁷ Fatty residues.
3⁷ Proteids.
1⁸ Principal substance of organic part of muscle.
2⁸ Chief proteid substances.
1⁹ Myosin.
1¹⁰ Can be converted into syntonin, another proteid substance.
2¹⁰ *Rigor mortis* or death stiffening produced by its coagulation.
2⁹ Kreatin. ($C^4\ H^9\ N^3\ O^2$).
3⁸ Beef teas.
1⁷ Myosin coagulated by heat, hence seldom found in beef tea.
2⁷ Liebig's extract is most valuable.
3⁷ More a stimulant than food.
4⁶ Breaks up by muscular work into.
1⁷ Proteids, carbon dioxide, sarcolactic acid, and possibly other things.
3⁴ Slightly alkaline in life.
4⁴ Acid in death.
1⁵ Work and death produce sarcolactic acid. ($C^3\ H^6\ O^3$).
10³ How muscles are named.
1⁴ From their form. *Deltoid, Rhomboideus.*
2⁴ From their location. *Tibialis, Ulnaris.*

3[4] From their attachments. *Sterno-Cleido-Mastoid.*

4[4] From their use. *Flexors. Extensors.*

5[4] From their number of divisions. *Biceps. Triceps.*

6[4] From their direction. *Obliquus.*

11[3] Principal muscles.

1[4] Of head and neck.

1[5] Occipito-frontalis. elevates eyebrows.

2[5] Orbicularis Palpebrarum. closes eyelids and compresses lachrymal gland.

3[5] Orbicularis Oris. closes mouth.

4[5] Masseter and Temporal. move lower jaw.

5[5] Sterno-Cleido-Mastoid. draws head forward or elevates sternum.

2[4] Of anterior part of trunk.

1[5] Pectoralis Major draws arm by the side. across the chest. and also draws scapula forward.

2[5] Serratus Magnus elevates ribs in inspiration.

3[5] Intercostal. elevates ribs in inspiration.

4[5] Obliquus Externus and Rectus Abdominis. bend Body forward. elevate hips. bend Body to side. etc.

3[4] Of posterior part of trunk.

1[5] Trapezius. Rhomboideus Major and Minor. draw scapula upward and backward. and elevate chin.

2[5] Latissimus Dorsi. draws arm by side and backward.

3[5] Serratus Posticus Inferior. depresses ribs in inspiration.

4[4] Muscles of upper extremities.

1[5] Deltoid. raises arm from side to horizontal position.

2[5] Biceps. flexes forearm on arm.

3[5] Triceps. extends forearm on arm.

4[5] Flexor Carpi Radialis. passes under annular ligament and bends hand on wrist.

5[5] Flexor Carpi Ulnaris. bends hand in direction of ulna.

6[5] Flexor Digitorum. bends fingers.

7[5] Extensor Digitorum. extends fingers.

8[5] Extensor Carpi Radialis. extends wrist on forearm.

5[4] Muscles of lower extremities.

1[5] Glutei, give power of retaining erect position.

2[5] Sartorius, bends lower extremities into position assumed by tailor. (*tailor's muscle*).

3[5] Rectus Femoris, Vastus Externus, and Vastus Internus, extend leg on thigh.

4[5] Triceps Abductor Femoris, bends thigh on pelvis, bends it outwardly and tends to bend limbs inwardly.

5[5] Biceps Femoris, forms outer hamstring, bends leg.—

6[5] Extensor Digitorum, passes under annular ligament, flexes foot, and extends four lesser toes.

7[5] Peroneus longus, extends foot and inclines sole obliquely outward.

8[5] Gastrochnemius Externus, raises Body in walking, and extends foot on leg.

9[5] Tendo-Achilles (heel cord) tendons of the Gastrochnemius Externus and Internus.

1[6] Fable of Achilles, and origin of name of tendon.

2[6] Capable of holding 1000 lbs. before it will break. *Mapother.*

12[3] Contractions of muscles.

1[4] Simple muscular contractions, *twitch.*

2[4] Tetanus, *tetanic contractions.*

13[3] Hygiene of muscles.

1[4] Pure blood necessary.

1[5] Digestive apparatus must be healthy.

2[5] Lungs must be properly expanded, and pure air supplied.

3[5] Skin kept warm by clothing and clean by bathing.

4[5] Freedom of circulation.

1[6] Secured by freedom from compression.

2[6] By proper exercise.

1[7] Varieties of exercise.

1[8] As to age.

2[8] As to health, circumstance, and occupation.

2[7] Relaxation must follow contraction.

1[8] Pupils can not sit too long in one position.

3[7] Change of employment may afford rest.
4[7] Muscles should be gradually called into action.
1[8] "Stitch in side." Value of training.
5[7] All parts of muscular system should have its appropriate share of exercise.
6[7] Condition of mind has a great influence upon tone of muscles.
7[7] Value of enforcing good habits of exercise and of position.
1[8] Wrong positions, in penmanship, in walking, in standing, etc., should be avoided.
14[4] Special physiology.
1[1] Motion.
1[5] By non-attachment to bones.
1[6] Mechanical levers not very evident.
2[5] By attachment to bones serving as levers.
1[6] Mechanical levers in body.
1[7] Classes.
1[8] First class.
1[9] Examples not very numerous.
2[9] Nodding and raising movements of head.
1[10] Fulcrum at atlanto-occipital articulation.
3[9] Varies in power.
2[8] Second class.
1[9] For great power.
2[9] Disadvantageous for rapidity and extent of movement.
3[9] Standing on toes.
1[10] Fulcrum, at contact with ground at the ball of the foot.
4[9] Fulcrum at end, power lifting.
3[8] Third class.
1[9] For quick movement and extent.
2[9] Fore-arm on humerus.
1[10] Power in middle of fore-arm.
2[10] Fulcrum at elbow joint.
2[7] Power lost by direction of pull.

2[6] Gives proper relation of muscle to bone.

3[5] Posture.

1[6] Difficulty of maintaining erect posture.

1[7] An effort of opposite muscles.

2[7] A larger balance given by different positions of lower limbs.

4[5] Locomotion, a result of motion, dependent on its own muscular effort. A falling and catching of one's self.

1[6] Passive organs of locomotion.

1[7] Bones.

2[7] Cartilages.

3[7] Ligaments.

2[6] Some locomotions.

1[7] Walking.

2[7] Running.

3[7] Leaping, etc.

5[5] Changes that occur in a contracting muscle.

1[6] Stimuli that tend to make it contract.

1[7] Natural or nerve.

2[7] Artificial.

1[8] Mechanical, as a pinch.

2[8] Heat.

3[8] Chemical.

4[8] Electrical.

2[6] Heat produced by contraction.

3[6] Carbonic and other acids produced.

4[6] Oxygen used up.

5[6] Oxidizable substance of muscle used up.

15[3] Diseases of muscles.

1[4] St. Vitus's Dance.

2[4] Convulsions.

3[4] Gout.

4[4] Rheumatism.

5[4] Lumbago.

6[4] Ganglion, (*weak or weeping sinew*).

NOTES.—

1. Abductors—Lat., *ab*, from, and *ducere*, to lead.
2. Adductors—Lat., *ad*, to, and *ducere*, to lead.
3. Bipenniform—Lat., *bis*, twice, *penna*, feather, and *forma*, form.
4. Biceps—Lat., *bis*, twice, and *caput*, head.
5. Biceps-femoris—Lat., *biceps*, and *femur*.
6. Digastric—Gr., *di*, twice, and *gaster*, belly.
7. Deltoid—Gr., *delta*, the Greek letter, and *eidos*, form.
8. Extensor—Lat., *ex*, out of, and *tendere*, to stretch.
9. Extensor Digitorum—Lat., *extensor*, see *supra*, and *digitus*, a finger.
10. Extensor Carpi Radialis—Lat., *carpus*, the wrist, and *radius*, a spoke.
11. Fusiform—Lat., *fusus*, spindle, and *forma*, form.
12. Flexors—Lat., *flectere*, to bend.
13. Fascia—Lat., *fascia*, a band.
14. Fasciculus—Lat., diminutive of *fascis*, a bundle.
15. Fulcrum—Lat., *fulcire*, to prop.
16. Flexor Carpi Radialis—Lat., See *supra*.
17. Flexor Carpi Ulnaris—Lat., See *supra* for flexor and carpi, and *ulna*, the elbow.
18. Flexor Digitorum—Lat., See *supra*, for words.
19. Glutei—Gr., referring to the buttocks.
20. Gastrochnemius Externus—Lat., *gaster*, the stomach, *knemē*, the leg, and *exter*, on the outside.
21. Intercostal—Lat., *inter*, between, and *costa*, a rib.
22. Kreatine—Gr., *kreas*, flesh.
23. Latissimus Dorsi—Lat., superlative of *latus*, broad, and *dorsum*, the back.
24. Muscle—Lat., *musculus*, diminutive of *mus*, a mouse.
25. Masseter—Gr., *massasiai*, to chew.
26. Occipito-Frontalis—Lat., *ob*, from, and *caput*, the head, also *frons*, the front.
27. Orbicularis Palpebrarum—Lat., *orbiculis*, diminutive of *orbis*, sphere or disk, and *palpebra*, the eyelid.
28. Orbicularis Oris—Lat., for first see *supra*, and *os*, the mouth.
29. Obliquus Externus—Lat., *ob*, from, and *liquis*, oblique, also *exter*, on the outside.
30. Penniform—Lat., *penna*, a feather, and *forma*, form.
31. Polygastric—Gr., *polys*, many, and *gaster*, belly.
32. Pronators—Lat., *pronare*, to bend forward.
33. Perimysium—Gr., *peri*, about, and Lat., *musculus*, the muscle.
34. Posture—Lat., *ponere*, to place.
35. Pectoralis Major—Lat., *pectus*, the breast, and *major*, comparative of *magnus*, great.
36. Peroneus Longus—Gr., *perone*, the fibula, and Lat., *longus*, long.
37. Rectus Abdominis—Lat., *rectus*, straight, and abdomen.
38. Rectus Femoris—Lat., *rectus*, straight, and *femur*.
39. Rhomboideus Major and Minor—from *rhomboid* and *major*, (see above) and *minor*, lower.
40. Sphincter—Gr., *sphingein*, to bind tight.
41. Superficial—Lat., *super*, above, and *facies*, shape.
42. Sarcolemma—Gr., *sarkos*, flesh, and *lemma*, rind.

43. Sarcolactic--Gr.. *sarkos*. flesh. and *lac*. milk.
44. Sterno-Cleido-Mastoid--*cleido*, referring to clavicle.
45. Serratus Magnus--Lat.. *serra*. a saw. and *magnus*. large.
46. Serratus Posticus Inferior--Lat.. *serra*. a saw. *post*. behind. and *inferus*. below.
47. Sartorius--Lat.. *sartor*. a tailor. so called because it is the muscle used so much by a tailor.
48. Tripenniform--*tri*, three. and *penniform*. see *supra*.
49. Tetanus--Gr.. *tetanos*. stretched.
50. Trapezius--Lat.. *trapezion*. diminutive of *trapeza*. a table.
51. Triceps--Lat.. *tres*. three. and *caput*. head.
52. Triceps Abducator Femoris--see *supra*.
53. Visceral--Lat.. *viscus*. one of the organs of the great cavities of Body.
54. Vastus Externus--Lat.. *vastus*. empty. and *exter*. on the outside.
55. Vastus Internus--Lat.. *vastus*. empty. and *internus*. within.

1. Nutrition.

1[1] Processes.

1[2] Reception of food.

2[2] Preparation of food.—Digestion.

3[2] Absorption.

4[2] Circulation.

5[2] Assimilation.

6[2] Disassimilation.

7[2] Excretion of waste.

2[1] Material necessary.

1[2] Foods.

1[3] Of what value.

1[4] As a source of energy.

1[5] Forms of energy.

1[6] Mechanical.

1[7] Muscular power.

2[6] Thermal.

1[7] Animal heat.

3[6] Chemical affinity.

1[7] Between atoms.

2[7] Potential force to start with in compound.

3[7] Kinetic force liberated in the combination.

4[7] Kinetic energy needed to tear compound apart.

5[7] The more stable the compound the more kinetic energy was liberated in the combination.

6[7] The more stable the compound, the more kinetic energy needed in tearing it down.

4[6] Electrical.

1[7] In muscle.

2[7] Produced by friction, heat, or chemical changes.

5[6] Magnetic.

1[7] Similarity to electrical.

6[6] Sound.

1[7] Beat of heart, heard.

2[5] Kinds of energy.

1[6] Kinetic.

1[7] Active energy.

2[7] Noticeable form in Body.

3[7] Define and discuss.

2[6] Potential.

1[7] Latent.

2[7] Exists between atoms of compounds, etc.

3[7] Define and discuss.

3[5] Source of kinetic energy.

1[6] By direct oxidation of material eaten.

2[6] By oxidation of tissues.

4[5] Capability of changing from one form of energy into another, or from one kind of energy into another.

1[6] Example.

1[7] From form to form.

1[8] Mechanical of muscle into heat energy.

2[7] From kind to kind.

1[8] Potential of coal made kinetic by combustion in steam engine.

2[8] Potential of tissue made kinetic by oxidation.

5[5] Loss of energy.

1[6] To atomsphere and surrounding objects.

2[6] Loss must be supplied or death results.

3[6] Loss cannot be supplied by the Body itself after a time.

4[6] Vital force can not account for a continuance of energy supply reaching over a series of years.

5[6] Necessity of food to supply that loss.

1[7] For muscular energy or power.

2[7] For animal heat, thermal energy.

3[7] For reserve supply.

1[8] In supplying tissue torn down.

2[8] In building up additional tissue.

6[6] Loss of material to supply loss of energy.

1[7] About 9 lbs.

6[5] Comparisons of energy and matter.

1[6] Both indestructible.

2[6] Energy and not matter is transmutable.

1[7] Iron or mercury cannot be changed to gold.

2[7] Capability of changing kinetic energy to potential or reverse.

7[5] Conservation of energy.

1[6] Principle of.—

1[7] "*The sum total of energy in all forms in the universe is always equal to a fixed quantity.*"

2[6] Law of.—

1[7] "*Energy or work power can be turned from one kind into another, and often back again, but never created from nothing or finally destroyed.*"

3[6] Illustration of it.—

1[7] In outside world.

1[8] In steam engine, coal with oxygen.

1[9] Heat produced, by fast oxidation combustion.

1[10] A start of combustion necessary.

2[9] Part of energy appears in thermal energy, part in mechanical, and part in other forms.

3[9] By requiring machine to rub surfaces together, same amount would again be produced minus the friction.

4[9] Heat energy may be transferred into electrical energy, etc.

5[9] Heat generally liberated more nearly at one point.

2[8] Iron rusting.

1[9] Slow oxidation in presence of moisture.

2[7] In man.

1[8] Why we eat and breathe.

1[9] To introduce oxygen and oxidizable matter.

2[8] Conditions of living cells start the oxidation at bodily temperature.

1[9] Slow oxidation, in presence of moisture.

1[10] Which gives off most heat, slow or fast oxidation?

2[9] Average temperature of Body, 98.5° F.—(37° C. about).

1[10] Varies with individual temperament.

2[10] Varies with the activity and use of Body.

3[10] Varies with surroundings.

4[10] Varies with bodily condition.

5[10] Warm-blooded animals die at 77° F. —(25° C.) or 120° F.—(49° C.)

3[8] Potential energy of tissue, or food material, changed to kinetic.

4[8] Oxidation takes place in systemic capillaries.

5[8] Human Body uses more of its energy than steam engine.

4[6] Law of, like the indestructibility of matter lies at base of all scientific conceptions of the universe, either animate or inanimate.

8[5] How liberated into kinetic energy in Body?

1[6] By chemical union.

1[7] Does not affect Body much.

2[7] Carbon oxidized in furnace.

1[8] $C+O=CO$.

2[6] *More stable compounds formed from less stable compounds.*

1[7] Its accompanying oxidation.

2[7] The great source of our energy.

3[7] Oxidation takes place by successive steps.

1[8] $C + O = CO$ (carbon monoxide).

2[8] $CO + O = CO^2$ (carbon dioxide).

3[6] Oxidation in presence of moisture.

4[6] Imperfect combustion in one organ completed in next.

9[5] Substances needed for kinetic energy.

1[6] Those that can be digested and absorbed.

1[7] Beeswax and cellulose of no value.

2[6] Those that can be oxidized at bodily temperature.

1[7] Things necessary for this oxidation.

1[8] Organic, oxidizable material—force generators.

2[8] Oxygen.

1[9] Lack of oxygen—suffocation.

1[10] Dropsy is suffocating, because the water in system will not permit a proper interchange

of oxygen with tissues.

3[6] Water, common salt, etc.

1[7] Value of—physical.

2[7] Salines influence solubility and chemical interchanges.

1[8] Fibrinogen, insoluble in pure water, at bodily temperature.

2[8] Fibrinogen, soluble in presence of common salt, at bodily temperature.

3[8] Belong to machinery formers.

10[5] Influence of starvation on energy.

1[6] Lowering of tone of Body and finally death.

2[6] Length of time a man might fast.

1[7] Depends on bodily conditions.

2[7] Depends on activity of Body.

3[7] Depends on surrounding conditions.

4[7] Depends on individual temperament.

5[7] Dr. Tanner's forty-day fast.

1[8] Value of a good warm covering,

6[7] Man only begins to starve after stored up material has been used.

7[7] Hibernation of bear and ground-hog.

2[4] As c tissue former.

1[5] Tissues are complex compounds.

2[5] Very high complez-compounds necessary to build up tissue.

1[6] Necssity of a complex food.

2[6] Proteids can not be manufactured by Human Body.

1[7] Only some of the lower forms, that possess *chlorophyll* can manufacture proteids.

2[7] Whence derived?

1[8] From animals and plants: in the end reaches plants.

1[9] Relation of animals and plants.

3[7] True, concerning any organic matter.

4[7] Proteid food must be taken to supply proteid want.

5[7] Man somewhat parasitic.

3[5] The great source of our energy.

2[4] How introduced?

1[4] By eating, drinking, and breathing.

2[4] Through receptive organs, etc.

3[3] Wastes of Body.

1[4] Income and wastes about equal.

1[5] Non-oxidizable food.

2[4] Food that has been or cannot be oxidized.

3[4] Chief wastes.

1[5] Average, about 9 lbs.

1[6] Carbon dioxide, (CO^2), 14114 grains.

2[6] Water, (H^2O). 47963 grains.

3[6] Urea, (CN^2H^4O). 531 grains.

4[6] Salts, such as sodium chloride, etc., 492.8 grains.

5[6] Other substances, 616 grains.

4[3] Relation of plants to animals.

1[4] Animals take in oxygen and give off carbon dioxide.

2[4] Plants take in carbon dioxide, and give off oxygen.

3[4] Animals can not make proteids.

4[4] Plants can make proteids.

5[4] Difference in their sensibility and irritability.

6[4] Difference in their power of moving from place to place.

7[4] Animals subsist in general on plants and animals.

8[4] Plants subsist on mineral and waste products.

9[4] Animals, except those that possess *chlorophyll*, can not make a proteid.

10[4] Plants can make proteids from simpler elements, and waste products.

5[3] Kinds as to oxidation.

1[4] Oxidizable.

1[5] Substances that can be oxidized at bodily temperature.

2[5] Force generators.

3[5] An oxidizable food needed to supply waste of oxidizable tissue.

2[4] Non-oxidizable.

1[5] Examples.

1[6] Water.

2[6] Common salt.

2[5] Value of, physical.

1[6] Fibrinogen insoluble in Body at bodily temperature, without presence of common salt.

2[6] Water dissolves material.

3[6] Water carries matter dissolved.

3[5] Force regulators.

6[3] Foodstuffs or alimentary principles.

1[4] Classes.

1[5] Inorganic (about 21).

1[6] Examples.

1[7] Water. H^2O.

1[8] Forms $\frac{2}{3}$ weight of Body.

2[8] Enamel of teeth contains least—2%.

3[8] Bones, about 22%.

4[8] Muscles, 75%.

5[8] Blood, 79%.

6[8] Saliva most, 99.5%.

2[7] Common salt, (NaCl), sodium chloride.

1[8] Privations men will endure for salt.

2[8] Value of, in preserving good condition of lower animals.

3[8] In all tissues.

3[7] Calcium phosphate.—$Ca^3 2PO^4$.

1[8] Large quantities needed in bones and teeth, less in others.

4[7] Hydrochloric acid.

1[8] Uncombined in stomach.

5[7] Potassium chloride. —KCl.

1[8] In muscles, blood, nerves, and most liquids.

6[7] Potassium phosphate.

7[7] Carbonate of lime or calcium.

1[8] Teeth.

1[9] Corroded by organic acids—hence teeth should be kept clean.

8[7] Ammonium chloride.

9⁷ Sodium phosphate.

10⁷ Magnesium phosphate.

11⁷ Sodium sulphate.

12⁷ Potassium sulphate.

13⁷ Calcium fluoride.

2⁶ Principally introduced in connection with other foodstuffs.

2⁵ Organic.

1⁸ Nitrogenous or azotized organic compounds.

1⁷ Principal divisions.

1⁸ Proteids or albuminous bodies.

1⁹ Type—egg-albumen.

2⁹ Simple elements found in it—C. H. N. O. S.

1¹⁰ Varies in percentage composition.

1¹¹ Carbon, 52—54%.

2¹¹ Hydrogen, 7—7.5%.

3¹¹ Oxygen, 21—24%.

4¹¹ Nitrogen, 15—17%.

5¹¹ Sulphur, .8—2%.

3⁹ Most important compounds in the Body.

1¹⁰ All active tissues of Body yield proteids.

1¹¹ Nitrogen of, carried off in urea.

2¹⁰ Body can not make proteid substance of something else.

3¹⁰ Proteid substances must be supplied to sustain life, and proteid want.

4¹⁰ Proteid substances can be changed from one form or variety to another.

1¹¹ Animal Body destructive, not constructive.

4⁹ Most important proteids.

1¹⁰ Serum albumen.

1¹¹ Blood. Boil for test.

2¹⁰ Fibrin.

1¹¹ Blood.

3¹⁰ Myosin.

1¹¹ Found in muscle.—lean meat.

4¹⁰ Syntonin.

1[11] Muscle.

5[10] Casein.

1[11] Found in milk and cheese.

6[10] Gluten and vegetable casein.

1[11] Found in various plants.

5[9] Test—subnitrate and pernitrate of mercury plus proteid give pink precipitate.

2[8] Peptones—albuminose.

1[9] Same elements and test as of proteids.

2[9] Formed from proteids in alimentary canal by digestive fluids.

3[9] Characteristic quality, diffusibility.

4[9] Differs from proteid in that it can be dialyzed.

3[8] Albuminoids.

1[9] Elements found in it.—C. H. O. N., rarely S.

2[9] Examples.

1[10] Gelatine.

1[11] Found in white fibrous tissue.

2[10] Chondrin.

3[10] Mucin.

2[7] Crystalline nitrogenous substances.

1[8] Principally broken down material.

2[8] Always contains "ammonium residues."

3[8] Most important.

1[9] Urea.

2[9] Uric acid.

3[9] Kreatin and kreatinin.

4[9] Taurocholic and glycocholic acids in bile.

3[7] Nitrogenous coloring matters.

1[8] Haematin—one element of haemoglobin.

1[9] It, with a proteid residue forms haemoglobin.

2[8] Cruorin. (*Cutter*).

3[8] Bilirubin, predominating in human bile, and bile of Carnivora.

4[8] Biliverdin, predominating in bile of Herbivora.

2[6] Non-nitrogenous or non-azotized organic compounds.

1[7] Classes.

1[8] Hydrocarbons.
1[9] Elements. C. H. O.
2[9] Average amount in man of 165 lbs is 6 lbs.
3[9] Principal ones.
1[10] Olein. ($C^{57}\ H^{104}\ O^6$).
2[10] Stearin. ($C^{57}\ H^{110}\ O^6$).
3[10] Palmatin. ($C^{51}\ H^{98}\ O^5$).
4[10] Stearin and palmatin solid at bodily temperature, but change when mixed with olein.
4[9] Other fats.
1[10] Margarin.
2[10] Butyrin.
5[9] Broken into glycerine and fatty acids by alkalies.
1[10] Fatty acids join with an alkali to form soup.
2[10] Oleic, stearic, palmitic, margaritic, and buytric acids.
6[9] Beeswax is a fat, but not digestible.
7[9] Distinction between fats and oils.
2[8] Carbohydrates or amyloids.
1[9] Elements. C. H. O.
1[10] Always one atom of oxygen to two of hydrogen.
2[9] Most important.
1[10] From animals.
1[11] Sugar of milk.—Lactose, ($C^{12}\ H^{22}\ O^{11}+H^2\ O$).
2[11] Glycogen. ($C^6\ H^{10}\ O^5$).—Animal starch.
1[12] Large quantities in liver—a reserve.
2[12] Smaller quantities in muscles.
3[11] Inosit or muscle sugar. ($C^6\ H^{12}\ O^6+2H^2\ O$).
1[12] Found in muscles, liver, spleen, kidneys, etc.
2[10] From other sources.
1[11] Glucose or grape sugar. ($C^6\ H^{12}\ O^6$).
1[12] Found in liver, blood, and lymph.
2[12] Formed by adding water. ($C^6\ H^{10}\ O^5+H^2\ O=C^6\ H^{12}\ O^6$).
2[11] Starch.
3[11] Dextrine.

4[11] Gums.

5[11] Cane sugar.

2[7] Non-nitrogenous organic acids.

1[8] Carbon dioxide, most important. (CO^2).

1[9] Nearly all carbon wastes leave the Body in this form.

2[8] Butyric, acetic, formic, stearic, palmitic, margaritic, and oleic acids.

3[8] Lactic. $(C^3 H^6 O^3)$.

1[9] Develops in milk, souring in stomach.

4[8] Sarcolactic acid. $(C^3 H^6 O^3)$.

1[9] Formed in muscles by work and death.

5[8] Glycero-phosphoric acid. $(C^3 H^9 PO^6)$.

1[9] Formed by decomposition of lecithin.

3[6] Greater number live and smaller number die on animal food than on vegetables.

7[3] Conditions a food must fulfill.

1[4] Must contain the elements needed by the Body in a form that can be built up.

1[5] Free nitrogen and hydrogen are no foods.

2[4] Must be capable of being digested and absorbed.

1[5] Carbon is of no value.

2[5] Food is outside of the Body while in alimentary canal.

3[4] Must be capable of being assimilated and oxidized at bodily temperature.

4[4] The substance itself nor any of its chemical transformations must be injurious to the activity of any organ of the Body.

8[3] Nutritive value of different foods.

1[4] Animal food—flesh in one sense.

1[5] Meats.

1[6] How cook?

1[7] Connective tissue changed into gelatin.

2[7] Proteid matter may pass out into broth and in part coagulate as scum.

3[7] If matter is to be retained in cooking meat, put it

in boiling water, if for soup, in cold.

2[6] Rich in proteids.

3[6] Possesses hydrocarbons in great degree.

4[6] Has some carbohydrates.

5[6] Pork least easily digested.

1[7] Trichina.

1[8] Need of thorough cooking.

2[7] Good percentage of fats.

3[7] Good food in cold weather.

6[6] Beef a valuable food.—easiest digested.

7[6] Salted meats not as good as fresh.

2[5] Milk.

1[6] Best food by itself.

2[6] Substances found in it.

1[7] Casein.

1[8] Cheese—an albuminous food.

2[8] Curd precipitated by development of lactic acid, or by artificial addition.

2[7] Fats. (butter).

1[8] Pellicle broken up by churning.

1[9] Globule surrounded by pellicle of albuminous matter.

3[7] Sugar of milk.

1[8] Changes into lactic acid by fermentation.

4[7] Mineral alimentary principles.

3[6] Reaction of human milk, slightly alkaline.

4[6] Reaction of cow's milk, slightly acid. (*Botch*).

5[6] Infants should not be fed on cow's milk unless prepared by a scientist.

3[5] Eggs.

1[6] Proteids of.

1[7] Egg albumen, white.

2[7] Vitellin in yolk.

2[6] Some fats.

3[6] Lecithin: containing muscle phosphorus.

4[6] Better soft than hard.

5[6] Highly nutritious.

2⁴ Vegetable foods.
1⁵ Wheat.
1⁶ 13½% proteids by weight, principally gluten.
1⁷ Forms a tenacious mass with water.
2⁶ 56.8% starch by weight.
3⁶ 4.9% sugar, and 1.9% fat by weight.
4⁶ Making of bread.
1⁷ Dough and yeast produce fermentation.
1⁸ CO^2 expanded and given off in baking.
2⁷ Heat fixes dough.
3⁷ Light-bread.
1⁸ Most pleasant to eat and more digestible.
2⁸ Formed by greatest fermentation and expansion.
2⁵ Corn.
1⁶ 7.9% proteid, 63.7% starch, and 5 to 8.7% fats by weight.
2⁶ More fats than any other grain.
3⁵ Rice.
1⁶ 5.6% proteid, and 82.3% starch by weight.
4⁵ Peas and beans.
1⁶ 22 to 26% proteids by weight—rich.
2⁶ About 50% starch.
5⁵ Potatoes.
1⁶ 13% proteids and 15.4% starch by weight.
2⁶ A poor food.
3⁶ A great amount of water and cellulose.
6⁵ Carrots, cabbages, turnips, etc., mainly valuable for salts.
7⁴ Cooking of vegetables.
1⁵ More valuable than flesh because of starch.
2⁵ Raw starch difficult of digestion.
1⁶ Digestive fluids act only on the granulose and not on cellulose.
3⁶ Roasted starch easily digested.
4⁶ Boiled starch better than raw.
5⁶ Crust of loaf of bread more digestible than the crumb, and toast than ordinary bread.

3[4] Is alcohol a food?

1[5] Does no good to healthy Body. (*Martin*).

2[5] Dangerous to use even in moderation.

3[5] May lead to an abnormal accumulation of fat and that where of least value.

4[5] Its purpose is, that of a whip in case of disease.

1[6] It is dangerous to the integrity of the organs.

5[5] Shrivels proteids of stomach wall if empty, or proteids of food, if full.

6[5] Tends to produce disease.

7[5] Does not lead to development of useful tissue, such as muscle, brain or gland.

8[5] Does not act as a strengthener.

1[6] Causes excitement of brain and even insanity.

2[6] Lowers capability of work power of muscles.

1[7] Experiments on soldiers.

9[5] Lowers heat of Body.

1[6] May make outside warmer but inside cooler.

2[6] Authority of Dr. Hayes, the Arctic explorer.

10[5] If used as a medicine, it should be used under the urgent advice of a good physician.

1[6] Its medicinal qualities are lowered for a habitual drinker.

4[4] Are tea and coffee foods?

1[5] More of a stimulant than a nutritious food.

2[5] Taken in excess, leave injurious after-effects.

3[5] None, or at least very little nourishment.

4[5] Better than alcohol.

9[3] Advantages of a mixed diet.

1[4] Overworking of the Body by one kind.

2[4] Starvation by one kind of diet.

3[4] So much must be eaten of one kind to supply another.

4[4] A gain of health.

5[4] A gain in cost.

6[4] A gain in nutrition.

7[4] Because of necessity of all kinds of foodstuffs.

8[4] Vegetarianism wrong. Too much carbon.

9[4] A normal appetite acting naturally. (a good guide) calls for it, often a craving.

1[5] A craving for a food acting naturally indicates that that food may be a good anti-scorbutic.

10[4] Gelatine, albumen and fibrin taken separately, only for a limited period nourish animals and that in an incomplete manner.

11[4] Foods properly seasoned are rendered agreeable.

12[4] Comparative anatomy of organs teach it.

2[2] Oxidizable matter required daily.

1[3] Depends upon waste. (about 5095 grains. .727 lb).

1[4] 4220 grains of carbon.

2[4] 292 grains of nitrogen.

3[4] 513 grains of hydrogen.

1[5] 4915 grains of hydrogen is introduced through water.

4[4] Oxygen is principally introduced through breathing: not an oxidizable matter.

2[3] Depends on temperament of person.

3[3] Depends on work performed and occupation.

4[3] Depends on diet.

5[3] Depends on climatic influence.

6[3] Depends on age.

7[3] Depends on habits.

8[3] Depends on mental condition.

9[3] Depends on clothing.

3[1] Organs carrying it on.

FOOD CHART—APPROXIMATE.

FOODS.	Water.	Nitrogenous organic food stuffs.	Hydro-Carbons	Carbohydrates.	Time to Digest.	
	%	%	%	%	Hours.	Minutes.
Milk	87.	4.7	3.5	4.8	2	15
Corn-bread	13.	15.	6.	66.	3	15
Wheat	12.5	21.4	1.9	64.2	3	30
Rice	9?	5.2	3.5?	82.3	1	00
Beans	13.	22.–26.	6–2.	59.	2	30
Peas	9.	26.	3.5	61.5	3	00
Potatoes	79.	1.5	.3	19.2	3	30
Turnips	83.	1.	.2	15.8	3	00
Eggs	72.5	19.3	82.		3	30
Beef	65.	22.5	12.5		3	00
Veal	68.	20.5	11.5		4	30
Pork	26.	8.	66.		5	15

TABLE FROM LANDOIS AND STIRLING'S PHYSIOLOGY.

Amount Required Daily by the Body, Excluding Water.

	At Rest.	In ordinary work	Hard Work.
	Ounces.	Ounces.	Ounces.
Proteids	2.5	4.6	6 to 7
Fats	1.0	3.0	3.5 to 4 5
Carbohydrates	12.0	14.4	16 to 18
Salts	0.5	1.0	1.2 to 1.5
TOTAL	16.0	23.0	26.7 to 31.

TABLE FROM LANDOIS AND STIRLING'S PHYSIOLOGY.

	Nitrogenous.		Non Nitrogenous.
1. Veal	10	to	1.
2. Rabbit's flesh	10	to	2.
3. Beef	10	to	17.
4. Beans	10	to	22.
5. Peas	10	to	23.
6. Mutton	10	to	27.
7. Pork	10	to	30.
8. Cow's milk	10	to	30.
9. Human milk	10	to	37.
10. Wheat flour	10	to	46.
11. Oatmeal	10	to	50.
12. Rye Meal	10	to	57.
13. Barley	10	to	57.
14. Potatoes	10	to	115.
15. Rice	10	to	123.
16. Buckwheat Meal	10	to	130.

1. Digestive Organs.

1[1] Necessity of?—Digestion.

1[2] Preparation of organic alimentary principles.

1[3] Nitrogenous.

2[3] Non-nitrogenous.

2[2] Inorganic principally introduced into Body as they exist in blood.

3[2] Time of digestion from two to four hours.

1[3] Dependent on the kinds of food.

2[3] Dependent on comminution in mastication, etc.

2[1] Peculiarities in other animals.

1[2] Simple pouch and single orifice of infusorial animalcules.

2[2] In mammalia, (including man).

1[3] Numerous glandular appendages.

2[3] Great length of intestines comparatively.

1[4] In herbivora.

1[5] Often four distinct divisions of stomach.*

1[6] *Paunch* or *Rumen*.

2[6] *Honeycomb* or *Reticulum*.

3[6] *Manyplies* or *Omosum*.

4[6] *Rennet* or *Abomosum*.

2[5] Alimentary canal, ten, twelve, and in some (the sheep) twenty times the length of the body.

3[5] Colon very large comparatively.

2[4] In carnivora.

1[5] Alimentary canal only three or four times the length of body.

2[5] Colon small comparatively because of smallness of residue of digestion.

3[4] In man.

1[5] Alimentary canal not as long as in herbivora and longer than in carnivora.

---

*1. It is very interesting to a person interested in physiology to examine these divisions in a beef or any herbivorous animal.

2. I would urge every student if possible to examine these divisions, especially in their structure.

2⁵ Process of digestion in mouth more complete than in carnivora and not so complete and laborious as in herbivora.

3¹ Classes of organs.

1² Glands.

1³ Where found?

1⁴ In all parts of Body.

2³ Their purpose.

1⁴ To secrete fluids.

1⁵ Value of fluids secreted.

1⁶ Chemical and physical.

2⁴ Gives large surface for contact.

3³ Kinds as to fluids secreted.

1⁴ Lachrymal.

2⁴ Perspiratory.

3⁴ Lymphatic.

4⁴ Digestive.

1⁵ Salivary.

2⁵ Mucous.

3⁵ Gastric.

4⁵ Peptic.

5⁵ Pancreatic.

6⁵ Liver.

7⁵ Solitary.

8⁵ Pyer's or agminated.

9⁵ Glands of Brunner.

10⁵ Crypts of Lieberkuhn.

5⁴ Ceruminous and Meibomian.

6⁴ Kidneys.

7⁴ Mammary.

4³ Kinds as to connection.

1⁴ Those that have ducts.

2⁴ Ductless.*

1⁵ Spleen, *milt*.

*The object in treating these in full at this point is to avoid them where we have no connection other than a proximity of location. It should be noted that they seem to have no function to perform in digestion.

1⁶ Situated at left end of stomach.

2⁶ Weight about 6 oz.

3⁶ Size, variable.

1⁷ Enlarges during digestion and afterwards shrinks.

2⁷ Enlarges during malarial disease, "ague cake."

3⁷ 5 inches long, 3 or 4 inches broad, 1½ inches thick.

4⁶ Location, left end of stomach.

5⁶ Structure.

1⁷ Connective tissue capsule covering.

1⁸ Processes thrown off from it, through the pulp and serving as framework.

2⁷ Arteries ramifying through it.

1⁸ On walls are found the *Malpighian corpuscles*.

6⁶ Functions only supposed.

1⁷ To destroy red corpuscles and to produce white.

2⁷ To produce red corpuscles and to destroy white.

3⁷ A source of digestive ferments in pancreas and stomach.

2⁵ The Thymus.

1⁶ Only exists in childhood.

1⁷ In neck and upper part of chest-cavity.

2⁶ Color—grayish pink.

3⁶ Structure.

1⁷ Texture—soft.

2⁷ Microscopically resembles lymphatic gland.

4⁶ Size.

1⁷ Largest at end of second year.

2⁷ Gradually atrophies till it almost disappears at the tenth to twelfth year.

5⁶ Function.

1⁷ If any, in youth. Supposed to be the formation of *lymph corpuscles*.

6⁶ It and pancreas sold as "sweetbread" by butchers.

3⁵ Thyroid Body.

1⁶ Location, in front of, and below "Adam's apple."

2⁶ Color—dark red-brown.

3⁶ Enlarged.

1⁷ In goitre.
2⁷ By drinking water containing magnesian limestone in solution.
1⁸ "Derbyshire neck," because common in Derbyshire, England.
4⁶ Function.
1⁷ Not very well known.
2⁷ More mucus found in Body after removal.
3⁷ Animals become idiotic.
4⁷ "*Myxodema*" is sometimes produced by disease of this gland.
4⁵ Suprarenal capsules.
1⁶ Located, one over top of each kidney.
2⁶ Function—problematical.
5⁵ Pituary body and pineal gland of brain.
5³ Kinds as to form and structure.
1⁴ Simple secreting surfaces.
1⁵ Example peritoneum, (not really a gland).
2⁴ Secreting surfaces increased by protrusions, follicular glands.
1⁵ Example, crypts of Lieberkuhn.
3⁴ Tubular.
1⁵ Simple.—Sudoriparous, and ceruminous.
2⁵ Compound.—Kidneys.
4⁴ Racemose.
1⁵ Simple—sebaceous, Meibomian, tracheal, etc.
2⁵ Compound—salivary, pancreas, lachrymal, etc.
6³ Parts of a true gland.
1⁴ Duct.
2⁴ Ductule.
3⁴ Secretory recesses.
1⁵ Kinds of secretions depend on lining cells.
7³ The liver the largest gland in the Body.
2² Alimentary canal divisions (with appendages).
1³ Mouth or buccal cavity.
1⁴ Boundary.
1⁵ At back by isthmus of fauces.

2^5 Palate at top.

1^6 Soft.

1^7 Uvula hanging from it.

2^6 Hard.

3^5 Lips and cheeks in front and sides.

4^5 Lower part of tongue below.

2^4 Accessory parts.

1^5 Teeth.

1^6 As to time of lasting.

1^7 Temporary.

1^8 Number—20.

2^8 Very short fang.

3^8 Roots of fang are absorbed. (*Hutchinson*).

2^7 Permanent.

1^8 Number—32.

2^6 As to form and use.

1^7 Incisors—cutting, $\frac{2}{2}\,\frac{2}{2}$.

1^8 Describe.

2^7 Canines.—tearing—cuspidatis. $\frac{1}{1}\,\frac{1}{1}$.

1^8 Describe.

3^7 Bicuspids—premolars, $\frac{2}{2}\,\frac{2}{2}$.

1^8 Describe.

2^8 Bicuspids of permanent, supply molars of temporary.

4^7 Molars—grinders—multicuspids, $\frac{3}{3}\,\frac{3}{3}$.

1^8 Last molar—*dens sapientiæ*—wisdom tooth.

2^8 Describe.

3^6 Dental equation.

1^7 For temporary: I $\frac{2}{2}\,\frac{2}{2}$, C $\frac{1}{1}\,\frac{1}{1}$, M $\frac{2}{2}\,\frac{2}{2}$.

2^7 For permanent: I $\frac{2}{2}\,\frac{2}{2}$, C $\frac{1}{1}\,\frac{1}{1}$, Bi $\frac{2+2}{2}\,\frac{2}{2}$, M $\frac{3}{3}\,\frac{3}{3}$.

4^6 Parts of.

1^7 Crown.

2^7 Neck or cervix.

3^7 Fang or root.

5^6 Structure.

1^7 Pulp cavity.

1^8 Filled in life by pulp.

1[9] Containing blood vessels and nerves.

2[5] Dentine or ivory.

1[8] Greater bulk.

2[8] Dentinal tubules, and interglobular spaces.

3[8] Intertubular tissue.

4[8] 72% Earthy matter.

3[7] Enamel on crown.

1[8] Enamel cuticle or cement on enamel.

2[8] Covering of tooth shading from crown to fang.

3[8] Only two to three per cent of organic matter.

6[6] Hygiene of.—

1[7] Teeth principally made up of carbonate of calcium.

1[8] Carbonate of calcium dissolves in weak acids.

2[7] Organic food remaining on teeth develops organic acids.

1[8] Why remove food?

3[7] A decayed tooth can not be replaced.

4[7] Brushing teeth with alkaline substances neutralizes the acids.

7[6] Alveolar process.

2[5] Tongue.

1[6] Attachment, at root to hyoid bone, also at lower mouth.

2[6] Structure musculo-membranous.

1[7] Capability of all kinds of movements.

3[6] Touch papillae of, imbedded in mucous membrane.

1[7] Circumvallate.

1[8] Longest and fewest—7 to 12 in number.

2[8] At root of tongue in shape of V.

3[8] Rounded elevations on side of, supposed to be concerned in taste—taste buds.

1[9] A few located in connection with fungiform.

2[7] Fungiform—

1[8] Over middle and fore part of tongue.

2[8] Bright red in color.

3[7] Filiform.

1[8] Smallest and most numerous.

2[8] High development in carnivora.
1[9] Value of.—Immense suction and scraping power.
1[10] Tamed tigers have been known to draw blood by licking master's hands.
4[6] *Furred tongue.*
1[7] Indicates disease of deeper part of digestive tract.
2[7] Composed of mucus, *bacteria*, and epithelial cells.
3[7] "Bad taste" in mouth.
5[6] Delicate touch, and excellent taste.
6[6] Uses of?
1[7] In movement of food.
2[7] Serves to articulate the voice.
3[7] Carries organs of taste.
3[5] Salivary glands.
1[6] Secretion of—saliva.
1[7] Uses of saliva.
1[8] Physical.
1[9] Moistens food.
1[10] So that it can be swallowed.
2[10] So that it can be tasted.
1[11] Organs of taste can only be reached when food is dissolved.
2[9] It, with mucus, keeps membrane of mouth and pharynx in suitable condition for speaking.
2[8] Chemical: *changes starch to sugar.*
1[9] Ptyaline, active principle.
2[7] Color, clear viscid fluid.
2[6] Kinds.
1[7] Parotid.—two.
1[8] Location—in front of ear and behind ramus of lower jaw.
2[8] Stenon's or Steno's ducts from them.
3[8] Seat of congestion in mumps (parotitis).
4[8] Opens near second molar tooth.
2[7] Submaxillary.—two.
1[8] Between halves of lower jaw bone at its angles.
2[8] Duct—Wharton's.

1⁹ Opens into mouth at fraenum linguae bridle of tongue.

3⁷ Sublingual.—two.

1⁸ Location—beneath floor of mouth, under tongue.

2⁸ Ducts—*ductus Riviani* 8—20.

1⁹ Bartholine duct formed by one or two sublingual, afterwards joining Wharton's.

3⁸ Purpose of submaxillary and sublingual to cover alimentary bolus with a viscid external coat.

4⁸ Submaxillary and sublingual secreted more frequently when sapid substances are introduced.

5⁸ Swelling under tongue called "frog" disease of sublingual.

3⁴ Absorption from mouth.

1⁵ Carbohydrates and mineral substances needing no digestion.

4⁴ Structure from within mouth inward.

1⁵ Mucous coat, or membrane.

1⁶ Sensitive to touch.

2⁵ Connective tissue or submucous.

3⁵ Muscular.

2³ Fauces.

1⁴ Boundary.

1⁵ Above soft palate and uvula.

2⁵ Below root of tongue.

3⁵ Sides—muscular elevations—pillars of fauces.

1⁶ Tonsils between pillars of fauces.

1⁷ Secretion of mucus.

2⁷ Enlarged tonsil in sore-throat.

1⁸ Produces deafness.

2⁸ Removal of for cure.

2⁴ Structure same as mouth.

3³ Pharynx.

1⁴ Shape—conical, upside down.

2⁴ Structure from within outward, musculo-membranous.

1⁵ Mucous membrane.

2⁵ Connective tissue.

3⁵ Muscular coat.

3⁴ Openings—7.

1⁵ Posterior nares—2.

2⁵ Eustachian tubes to ears—2.

3⁵ Into oesophagus—1.

4⁵ Through fauces into mouth—1.

5⁵ Into larynx through glottis.

1⁶ Epiglottis covering glottis.

1⁷ Triangular spoon-shaped cartilage.

2⁶ "Food going wrong way."

4⁴ Mucous glands, numerous.

5⁴ Blood vessels, numerous.

4³ Oesophagus.

1⁴ Location—pharynx to stomach.

1⁵ Behind windpipe.

2⁴ Size.

1⁵ Diameter, about ¾ inch.

2⁵ Length 9 or 10 inches, varies.

3⁴ Structure from within out.

1⁵ Mucous coat.

1⁶ Numerous mucous glands in it, (*racemose*).

2⁵ Submucous coat or connective tissue.

3⁵ Muscular.

1⁶ Longitudinal—external.

2⁶ Circular or transverse—internal.

4⁵ Through thoracic cavity, serous coat (a reflection of pleura).

5³ Stomach.

1⁴ Shape—pear shaped—curved conical bag—resembles a bagpipe.

2⁴ Size. (*Flint*).

1⁵ Length 13 to 15 inches (10 inches—*Martin*).

2⁵ Widest diameter 5 inches: average 3 or 4 inches.

3⁵ Capacity about 5 pints.

3⁴ Clear anatomical points.

1⁵ Curvatures.

1⁶ Lesser.

2[6] Greater.
1[7] Great omentum or caul.
1[8] "Capon lined belly."
2[7] Small omentum.
2[5] Pouches.
1[6] Fundus or great *cul de sac*.
1[7] Left end.
2[6] Lesser pouch.
3[5] Openings.
1[6] Cardiac or oesophageal.
2[6] Pyloric.
1[7] Sphincter muscle.
2[7] Cause of regular opening? Probably a certain degree of acidity of chyme.
4[5] Structure.
1[6] Mucous coat within.
1[7] Mucous glands.
2[6] Submucous.
3[6] Muscular.
1[7] External longitudinal layer.
2[7] Internal circular layer.
3[7] Median or oblique layer.
4[6] Peritoneal or serous layer.
4[4] Blood vessels.
1[5] Under or between peritoneal coats.
5[4] Nerves.
1[5] Pneumogastric.
1[6] Branches of, to.
1[7] Pharynx.
2[7] Gullet.
3[7] Stomach.
4[7] Larynx.
5[7] Trachea.
6[7] Lungs.
7[7] Heart.
8[7] Small intestines—right one.
2[5] Sympathetic.

6⁴ Palpitation of heart produced by over distended stomach.

7⁴ Peristaltic action.

8⁴ Fistula of St. Martin.

9⁴ Glandular organs of.

1⁵ Mucous.

2⁵ Gastric.

1⁶ Classes.

1⁷ Gastric proper.

2⁷ Peptic.

1⁸ More numerous than gastric proper.

2⁸ Essential digestive ingredient secreted by them —pepsin.

2⁶ Secretion—gastric juice.

1⁷ Active principles.

1⁸ Pepsin: the most essential ingredient.

2⁸ Rennin has power of coagulating milk.

3⁸ Rennin and pepsin active only in presence of acid.

1⁹ Acid of stomach—hydrochloric. (HCl).

10⁴ Regurgitation and eructation.

1⁵ Discuss the case of Cambay. (*Flint*).

2⁵ Compare to action of cud chewing of ruminants.

6³ Intestines. (25 ft. +).

1⁴ Divisions.

1⁵ Small.

1⁶ Length—20 ft., varies.

2⁶ Diameter.

1⁷ Pyloric end, 2 inches.

2⁷ Caecal end, $1\frac{1}{2}$ inches.

3⁶ Structure.

1⁷ Support—mesentery.

1⁸ A sort of continuation of membranes of intestines.

2⁸ Purpose.

1⁹ Folds intestines and gives a long contorted course.

2⁹ Prevents knotting.

3⁹ Allows a certain amount of motion.

1[10] Two motions.
1[11] Peristaltic towards large intestines.
2[11] Antiperistaltic towards stomach.
2[10] Value of?
1[11] A method of carrying material onward.
2[11] Mixes food with juices.
2[7] Coats.
1[8] Mucous, within.
1[9] Color, pink. Why? Very vascular.
2[9] Valvulae conniventes.
1[10] Permanent transverse folds.
2[10] Location.
1[11] First found two inches from pylorus.
2[11] Largest and most numerous, upper half of jejunum.
3[11] Disappear in upper half of ileum.
3[10] Purpose.
1[11] Gives greater surface for absorption, secretion, and excretion.
2[11] Delays progress of food, so it can be digested and absorbed.
3[9] Villi.
1[10] Lengh $\frac{1}{50}$ to $\frac{1}{25}$ inch.
2[10] Shape. Flattened cylinders or cones. (*Flint*).
1[11] $\frac{1}{70}$ to $\frac{1}{120}$ inch in diameter.
3[10] Structure.
1[11] Covering columnar epithelium.
2[11] Interior.
1[12] Connective tissue enclosing blood vessels, nerves, and lymphatics.
1[13] Four, five, and even fifteen arterioles present.
2[12] Beginning of lacteals.
4[10] Location.
1[11] On top and between valvulae conniventes.
5[10] Most numerous in duodenum and jejunum.
1[11] 7200 to 13000 villi to a square inch in duodenum.

2[11] 5700 to 10000 villi to a square inch in ileum.
3[11] 10125000 villi in small intestine. (*Sappey*).
6[10] Not found in large intestines.
7[10] Crypts of Lieberkuhn open between villi.
8[10] Glands of Brunner opening through it.
4[9] Glands located in it.
1[10] Crypts of Lieberkuhn.
2[10] Solitary glands or follicles.
3[10] Pyer's patches or agminated glands.
2[8] Submucous—second coat.
1[9] Glands of Brunner in it, within duodenum—duodenal racemose glands.
2[9] Matrix for blood vessels and nerves.
3[8] Muscular.
1[9] Coats of ?
1[10] Longitudinal and transverse.
4[8] Serous or peritoneal.
4[6] Divisions.
1[7] Duodenum.
1[8] Length, 8 to 10 inches (*Flint*). 12 inches (*Martin*).
2[7] Jejunum.
1[8] Generally empty after death, hence the name.
2[8] Nearly 8 ft. long.
3[7] Ileum.
1[8] Ileo-caecal or ileo-colic valve at termination.
1[9] Also called *valvula Bauhini*.
4[6] Openings.
1[7] Openings of, from glands of intestinal wall.
2[7] From pancreas—[the "abdominal salivary gland"?]
1[8] Location of pancreas.
1[9] Transversely and dorsally, just beneath the stomach.
2[9] Larger end to right.
2[8] Weight, 4 to 5 ounces. (*Flint.*)
3[8] Shape.
1[9] Length 6 to 8 inches.
2[9] Breadth, from 1½ inches down.
3[9] Thickness, ¾ of an inch.

4[8] Peritoneum only covers ventral side, because located behind it.

5[8] Ducts, two. (*Bernard*).

1[9] Main duct joins common bile duct.

1[10] Canal of Wirsung or pancreatic duct.

2[10] Enters intestine 4 inches from pylorus.

2[9] Accessory duct an inch above main duct.

3[9] Pancreatic fistula.

6[8] Into duodenum.

7[8] Secretion called pancreatic juice.

1[9] Active principle—trypsin.

3[7] From liver—hepar.

1[8] Duct,—common bile duct, (*ductus communis choledochus*).

1[9] Branches forming it.

1[10] Cystic.

1[11] From cystic division of bladder.

2[10] Hepatic.

1[11] From hepatic division of bladder.

2[9] Empties 4 inches from pylorus.

2[8] Functions.

1[9] Excretory.

1[10] Bile.

1[11] Effect of a biliary fistula.

2[11] Yellow jaundice.

2[10] Cholestrine.

2[9] Secretory or glycogenic.

1[10] Glycogen stored up for future use.

3[8] Largest gland in Body.

4[8] Location, right side of abdomen, just beneath diaphragm: *the right hypochondriac region.*

5[8] Weight 50 to 64 ounces.

6[8] Color—dark reddish-brown.

7[8] Measurements.

1[9] 10 to 12 inches transversely.

2[9] 6 to 7 inches antero-posteriorly.

3[9] 3 inches thick in thickest part.

8[8] Structure.
1[9] Outside covering—*peritoneum.*
2[9] Second layer—*capsule of Glisson.*
1[10] Lines portal canals of organ.
3[9] Lobules.
1[10] Size of loblues, $\frac{1}{25}$ to $\frac{1}{2}$ of an inch.
2[10] Lobules made up of hepatic cells.
1[11] Supported by a close net work of capillaries.
2[11] Diameter about $\frac{1}{1500}$ inch.
4[9] Portal canals.
1[10] Vessels found in each.
1[11] Branch of portal vein.
2[11] Branch of hepatic artery.
3[11] Branch of hepatic duct for bile.
2[10] Lead to interlobular plexus.
1[11] Intralobular veins formed.
1[12] Sublobular veins receive these.
1[13] Form hepatic veins.
5[9] Lobes.
1[10] Right.
1[11] Much the larger.
2[10] Left.
4[7] Into stomach.
1[8] Closure abrupt on intestinal side.
5[7] Into large intestine.
5[6] Nerves of small intestines.
1[7] Right pneumogastric and not left.
2[7] Sympathetic.
2[5] Large.
1[6] Length about 5 ft.
2[6] Diameter $1\frac{1}{2}$ to $2\frac{1}{2}$ inches: ($2\frac{1}{2}$ to $3\frac{1}{2}$ at beginning and $1\frac{3}{4}$ to $2\frac{3}{4}$ at ending.—*Flint*).
3[6] Divisions.
1[7] Caecum.
1[8] Vermiform appendix.
1[9] Use unknown.
2[8] Ileo-caecal or ileo-colic valve right beneath colon.

2[7] Colon.
1[8] Ascending.
2[8] Transverse.
3[8] Descending.
1[9] Sigmoid flexure its lower part.
3[7] Rectum.
4[6] Structure.
1[7] External appearance.
2[7] Coats.
1[8] Mucous.
2[8] Submucous.
3[8] Muscular —(longitudinal and transverse).
4[8] Serous.
3[7] No villi or valvulae conniventes, but often folds like in stomach.
4[7] Contains numerous glands resembling crypts of Lieberkuhn.
2[4] Belong to abdominal viscera.
1[5] Other divisions of it.
1[6] Liver.
2[6] Pancreas.
3[6] Spleen.
4[6] Kidneys.
5[6] Stomach.
7[3] Terms to develop the relation of inside of alimentary canal to outside of Body.
1[4] Inside of inside.
2[4] Inside of outside.
3[4] Outside of outside.
4[4] Outside of inside.

NOTES:—

1. Bicuspid—Lat., *bis*, twice, and *cuspis* a point.
2. Carnivora—Lat., *caro, carnis*, flesh, and *vorare*, to devour.
3. Crypt—Gr., *krypteín*, to hide; a small cave or tomb beneath the surface.
4. Ceruminous—Lat., *cera*, wax.
5. Canine—Lat., *canis*, a dog.
6. Circumvallate—Lat., *circum*, around, and *vallum*, a rampart.
7. Cardiac—Lat., *cardium*, the heart.
8. Cholestrine—Gr., *chole*, bile, and *stear* stiff fat.—*A fatty substance resembling spermaceti, found in the bile and biliary excretions.*
9. Caecum—Lat., *caecus*, blind.
10. Dentine—Lat., *dens*, a tooth.
11. Duodenum—Lat., *duodeni*, twelve each.
12. Eustachian—named after the learned Italian physician, Eustachi.
13. Epiglottis—Gr., *epi*, upon, and *glotta*, the tongue.
14. Fungiform—Lat., *fungus*, mushroom and *forma* shape.
15. Filiform—Lat., *filum*, thread, and *forma*, form.
16. Fistula—Lat., *A permanent abnormal opening into the soft parts with a constant discharge.*
17. Gland.—Lat., *glans*, an acorn: literally a little acorn.
18. Glottis—Gr., *glotta*, the tongue.
19. Gastric—Gr., *gaster*, the belly or stomach.
20. Glycogen—Gr., *glukus*, sweet, and *genos*, birth.
21. Herbivora—Lat., *herba*, an herb, and *vorare* to devour.
22. Incisor—Lat., a cutter.
23. Ileum—Gr., *eileín*, to roll or twist up.—
24. Intestine—Lat., *intus*, within.
25. Jejunum—Lat., *jejunus*, empty, dry: so called because generally found empty after death.
26. Lachrymal—Lat., *lacryma*, a tear.
27. Meibomian, discovered by Meibomius.
28. Mammary—Lat., *mamma*, the breast.
29. Molar—Lat., *mola*, mill.
30. Mesentery—Gr., *mesos*, middle, and *enteron*, intestine.
31. Oesophagus—Gr., *Oiso*, to carry, and *phageín*, to eat.
32. Perspiratory—Lat., *per*, through, and *spirare* to breath.
33. Parotid—Gr., *para*, near and *otos* genitive of *ous* the ear.
34. Pre-molars—Lat., *pre*, before, and molars.
35. Ptyaline—Gr., *ptyein*, to spit.
36. Pylorus—Gr., *puloros*, a gate keeper.
37. Pneumogastric—Gr., *pneumon*, a lung, and *gaster*, stomach.
38. Peristaltic—Gr., *peri*, around, and *stallein*, to place or arrange.
39. Pepsin—Gr., *pepteín*, to cook or digest.
40. Peritoneum—Gr., *peri*, around and *teineín*, to stretch.
41. Pancreas—Gr., *pan*, all, and *kreas*, flesh.
42. Rectum—Lat., *rectus*, straight.
43. Sub-maxillary—Lat., *sub*, under and *maxilla* diminutive of *mala*, the jaw.
44. Sub-lingual—Lat., *sub* under, and *lingua*, the tongue.
45. Supra-renal—Lat., *supra*, above, and *renes*, the kidneys.

46. Sudoriparous—Lat., *sudor*, sweat, and *parare*, to furnish.
47. Sebaceous—Lat., *sebum*, tallow.
48. Sigmoid—Gr., *sigma*, a letter of Greek alphabet, and *eidos*, form.
49. Sphincter—Gr., *sphingo*, to restrict.
50. Sympathetic—Gr., syn, with, and pathos, suffering.
51. Thyroid—Gr., *thyra*, a door and *eidos*, form.
52. Trachea—Gr., *trachus*, rough.
53. Transverse—Lat., *trans*, across, and *vertere*, to turn.
54. Uvula—Lat., diminutive of *uva* a grape.
55. Villus—Lat., a shaggy hair.

1. Digestion.

1[1] Purpose.
1[2] Prepares food for dialysis or absorption.
1[3] Kinds of preparation.
1[4] Physical.
1[5] Dissolves food needing no digestion.
1[6] Examples—sugar and salt.
2[5] Aids in carrying food along.
1[6] Moistens food.
2[6] Moistens membrane of canal.
3[5] Aids in speaking.
2[4] Chemical.
1[5] Object.
1[6] Changing non-dialyzable foods into dialyzable.
1[7] Example—proteids into peptones.
2[6] Changing insoluble bodies into soluble.
1[7] Example—starch into sugar.
2[5] Kinds of food needing this change.
1[6] Nitrogenous.
2[6] Non-nitrogenous.
1[7] Sugars do not need this preparation.
2[1] Things necessary in full digestive act.
1[2] A place for reception of food—(*alimentary canal*).
1[3] Reception of food.
2[3] Actions of canal.
2[2] Digestive fluids.
1[3] In mouth.
1[4] Saliva.
1[5] Glands secreting it.
1[6] Classes.
1[7] Parotid.—2.
2[7] Submaxillary.—2.
3[7] Sublingual.—8 to 20.
2[6] Racemose in form.
2[5] Ropy power of submaxillary and sublingual secretions to parotid.
3[5] Purpose.

1[6] Physical and mechanical.

1[5] Dissolves sugar and salts.

1[4] Only dissolved substances can be tasted.

1[3] Organ of taste inward from surface.

2[3] Place sugar on dry tongue, for test.

2[4] Dissolved substances can be dialyzed.

2[5] Moistens food for swallowing.

1[4] Swallowing of crackers and East Indian rice ordeal.

3[5] Saliva with mucus serves a good purpose in speaking.

1[4] Young orator and lack of saliva because of fear.

2[6] Chemical.

1[5] Changes starches to sugar.

1[4] By ptyaline.

2[4] Example—$C^{6}H^{10}O^{5} + H^{2}O = C^{6}H^{12}O^{6}$.
Starch. + Water. = Sugar.

2[5] Stimulates flow of gastric juice.

1[4] Value of carbonate of soda in some forms of dyspepsia, also *apollinaris water*.

2[4] Why chew food well?

4[5] Chemical nature—*alkaline*.

1[6] Ptyaline acts only in alkaline medium.

1[7] Does not act in stomach.

2[7] Begins its action again in intestines.

5[5] Active principle—ptyaline or animal diastase. (*Mialhe*).

1[6] A *ferment* or *enzyme*.

1[7] Ferments of digestive secretions bring about changes but do not decrease in quantity. They belong to the chemical category of *contact actions*.

2[7] Changes take place easiest at the temperature of Human Body.

2[6] Pure alcohol will coagulate it.

6[5] Food should be reduced to a pultaceous mass.

7[5] Composition of human saliva. (*Bidder and Schmidt*).

1[6] Water in 1000 parts. 995.16

2⁶ Epithelium in 1000 parts. 1.62
3⁶ Soluble organic matter in 1000 parts. 1.34
4⁶ Sulpho cyanide of potassium in 1000 parts. .06
5⁶ Phosphates of soda, lime, and magnesia, in 1000 parts. .98
6⁶ Chloride of potassium, / .84
7⁶ Chloride of sodium, \
8⁶ Color—clear viscid fluid.

2⁴ Mucus.

1⁵ Of no other value than physical or mechanical.
2⁵ Aids in covering alimentary bolus with viscid substance.
3⁵ Secreted all along alimentary canal.

3⁴ Swallowing or deglutition.

1⁵ Stages.

1⁶ First stage, from mouth to pharynx.

1⁷ Gathering of food on back part of tongue.

2⁶ Second stage.

1⁷ Through pharynx.

1⁸ Epiglottis.
2⁸ Larynx raised.
3⁸ Blocking of all passages out of pharynx except oesophagus.

2⁷ Fauces the "Rubicon" of canal.
3⁷ Most rapid part. Why?
4⁷ Pharyngeal muscles principally involuntary.

3⁶ Third stage.

1⁷ Slow.
2⁷ Action of muscular coat of oesophagus—vermicular or peristaltic.

1⁸ Drinking of water standing on one's head. How?

2⁵ *Center of deglutition* in *medulla oblongata*.

2³ Of stomach.

1⁴ Gastric juice.

1⁵ Active principles or enzymes.

1⁶ Pepsin.
2⁶ Rennet.

1⁷ Curdled milk regurgitated by infant not a sign of disordered stomach.

2⁷ Purpose, principally chemical.
1⁸ Gelatine-yielding connective tissue or albuminoids of meats dissolved.
2⁸ Non-dialyzable proteids changed to dialyzable peptones and parapeptones.*
1⁷ Proteids belong to a class called colloids.
3⁶ Certain mineral salts (as phosphates of lime, insoluble in water, but soluble in dilute acids) are prepared here.
4⁶ Food mass in time reduced to chyme, a sort of thick soup of grayish color.
3⁵ Thin, colorless, or pale yellow liquid.
4⁵ Chemical nature—acid.
1⁶ Gastric juice acts only in acid medium.
5⁵ Glands secreting it.
1⁶ Gastric.
1⁷ Classes.
1⁸ Gastric proper.
2⁸ Peptic.
2⁶ Belong to racemose type.
2⁴ Mucus by mucous glands.
3⁴ Time of stomach digestion.
1⁵ Part passed on in 1½ to 2 hours.
2⁵ Stomach empty in 3 or 4 hours.
4⁴ Actions of stomach.
1⁵ Peristaltic action.
2⁵ Opening of pyloric sphincter at intervals.
1⁶ Cause, probably acidity of stomach contents.
5⁴ Material of stomach digestion passed on.
1⁵ Chyme.
1⁶ Fats and oils.
2⁶ Undigested proteids and unabsorbed peptones and parapeptones.
3⁶ Unabsorbed sugars and undigested starches.
4⁶ Indigestible substances.

*Martin H. B. 349.

5[6] Saliva, mucus, and gastric juice.
6[6] Unabsorbed salines, etc.
6[4] Fistula in St. Martin. (*Flint*).
3[3] Of intestines.
1[4] Principal force in small intestines.
2[4] Classes of.—
1[5] Pancreatic juice.
1[6] Clear watery, much like saliva in appearance.
2[6] Secreted by pancreas, "abdominal salivary gland" of Germans.
3[6] Active principle or enzyme, ptyaline.
1[7] Acts only in alkaline medium.
4[6] Chemical nature—alkaline.
5[6] Powers, principally chemical.
1[7] Converts starch into sugar.
2[7] Dissolves proteids (if necessary) and converts them into peptones.
3[7] Changes albuminoid substances if necessary.
4[7] On fats.
1[8] Emulsifies fats.
1[9] Albumin of pancreatic secretion has this power.
2[9] Mix white of egg with oil in experiment.
2[8] Breaks fats into glycerine and fatty acids.
1[9] Example of chemical formula representing change.

$$\underset{C^3H^5}{(C^{18}H^{35}O)^3}O^3+3H^2O=3\underset{H}{(C^{18}H^{35}O)}O)+\underset{H^3}{C^3H^5)O^3}$$

Stearin + 3Water=3Stearic acid+1Glycerine.

2[9] Glycerine and fatty acids are then saponified and absorbed.*
3[8] Principal fats and oils, and corresponding acids.
1[9] Olein—oleic.
2[9] Stearin—stearic.
3[9] Palmatin—palmitic.

*Ordinary soap is a compound of a fatty acid with soda, colored and scented by the addition of various substances. Soft soap is a compound of a fatty acid with potash. Both dissolve in water, but the fats by themselves are not soluble.

4⁹ Margarin—margaric.

5⁹ Butyrin—butyric.

2⁵ Succus entericus, intestinal juice.

1⁶ Secreted by glands of Brunner and crypts of Lieberkuhn.

2⁶ Functions.

1⁷ Dissolves blood fibrin and converts it into peptones.

2⁷ Cane sugar changed to grape sugar.

3⁷ Aids in overcoming acidity of chyme.

3⁶ Chemical nature—alkaline.

3⁵ Mucus. (secreted by mucous glands).

1⁶ Of no particular value other than physical.

4⁵ Secretions of Pyer's patches and solitary glands.

1⁶ Helps to overcome acidity of chyme.

5⁵ Bile.

1⁶ Composition.

1⁷ Coloring matters.

2⁷ Mineral salts.

3⁷ Water.

4⁷ Sodium salts of *taurocholic* and *glychocholic* acids.

5⁷ Mucin in it.

2⁶ Chemical nature—alkaline.

3⁶ Color, golden brown liquid when fresh, green in time.

4⁶ Ducts used.

1⁷ Common bile duct—*ductus communis choledochus*.

1⁸ Hepatic.

2⁸ Cystic.

5⁶ Uses of.

1⁷ Probable.

1⁸ Furnishes liquid for easy movement of food in intestines.

2⁸ Overcomes acidity of gastric juice in chyme.

1⁹ Allows trypsin of pancreatic juice to act.

3⁸ Prevents constipation.

4⁸ Probably an *antiseptic*: i. e., retards putrefactive changes of foods.

5⁸ Promotes absorption of fats, by soaking epithelial cells that line intestines.

6⁸ Acts as a stimulus to muscular coating of stomach.

2⁷ Not so fixed, and well determined.

1⁸ Entrance of duct in connection with pancreatic duct.

2⁸ Study of, in rabbit—bile duct enters a foot above pancreatic duct.

6⁵ Saliva begins its activity here.

3⁴ Result of digestion in intestines.

1⁵ Chyme changed to chyle.

2⁵ All digestible matter remaining undigested, digested here.

3⁵ Digestion in small intestines more than in large.

4⁴ Bacteria in intestines.

3³ Absorption.

1³ Through blood and lymphatic vessels,—dialysis.

1⁴ Located along entire canal.

2³ From mouth, pharynx, and gullet.

1⁴ Sugars, salts, water, etc.

2⁴ Very small.

3³ From stomach.

1⁴ Sugars, salines, water, peptones, albuminoids, etc.

2⁴ Very important.

4³ From small intestines.

1⁴ Very important: great place of absorption.

2⁴ Materials.

1⁵ Sugar formed or reaching it.

1⁶ Sugar formed from animal and vegetable starch.

2⁵ Peptones, emulsified and saponified fats, water, salines, etc.

3⁴ Value of *valvulae conniventes* and *villi*.

5³ From large intestines.

1⁴ Not very great.

2⁴ Water, sugars, fats, etc.

3² Materials thrown from the Body through alimentary canal.

1² Elastic tissue, cellulose, mucin, and beeswax.
2² Ferments of digestive secretions, and worn out tissues.
2² Water and unabsorbed fats, starches, salts, bile, pigments, etc.
4¹ Kinds of digestion, according to foodstuffs digested.
1² Of fats, of starches, of proteids, etc.
5¹ Kinds as to place.
1² Mouth, stomach, intestinal, etc.

☞For derivations, see previous outline.

TABLE SHOWING THE ALIMENTARY PRINCIPLES EATEN AT AN ORDINARY MEAL. (*MARTIN H. B.*)

	INORGANIC FOODSTUFFS.			CARBOHYDRATES.			FATS.	NITROGENOUS ORGANIC BODIES.		
	Water.	Salts soluble in water.	Salts insoluble in water.	Starch	Sugars	Indigestible substances.		Proteids	Albuminoids.	Indigestible substances.
Bread contains.	Water.	Common salt and others.	Calcium phosphate. Calcium sulphate.	Starch	Grape sugar.	Cellulose.	Small quantities of several.	Gluten. Vegetable casein.		
Butter contains.	Water.	Common salt and others.					Butyrin and other	Casein in small quantity.		
Cooked beefsteak contains.	Water.	Potassium phosphate. Common salt and others			Inosite or grape sugar.		Stearin. Palmatin Margarin Olein.	Myosin. Sytonin. others less.	Gelatin.	Elastic tissue.
Potatoes contain.	Water.			Starch		Cellulose.	A trace.	A very small quantity.		
Milk contains.	Water.	Common salt and others. especially phosphates.	Calcium phosphate. Iron phosphate.		Milk Sugar.		Butyrin and other fats.	Casein.		

1. Blood and Lymph.

1¹ Necessity for them in Human Body.

1² To carry nutritive matter to tissues: (nutrition).

1³ Man is a complex organization.

2³ Every part needs a constant renewal of food or death results.

3³ Oxygen must reach every part or animal heat can not be produced.

4³ Man's complexity makes it impossible to receive proper nourishment except through a medium.

5³ Blood and lymph act as middlemen or commercial carriers from receptive organs to tissues.

2² To carry broken down matter to excretory organs.

1³ Internal cells would soon become overloaded, if wastes were not removed.

2³ Disease and putrefactive changes would occur, if wastes were not removed.

3³ Complexity of man compels a system to carry wastes out.

4³ Blood and lymph serve as that medium.

3² To regulate temperature and secretions.

2¹ Animals that are small and of simple structure need no blood.

1² Example—amoeba.

2² The more complex the animal the more need for blood.

3¹ Blood.

1² Parts supplied with it—*vascular tissues.*

2² Parts not supplied with it—*non-vascular tissues.*

1³ Chief non-vascular tissues.

1⁴ Cuticle.

1⁵ Test by pricking with a pin.

2⁴ Hairs.

3⁴ Nails.

4⁴ Hard parts of teeth.

5⁴ Most cartilages.

6⁴ Refractory media of eye.

2³ Non-vascular tissues nourished by transfusion of liquids through walls of blood vessels into neighboring parts.

3[2] Color—red.
1[3] Due to great number of red (singly yellow) corpuscles and different refractive power.
4[2] Odor, faint but characteristic.
1[3] Developed by a few drops of sulphuric acid.
2[3] Different in different individuals.
5[2] Taste: saline, because of chloride of sodium in plasma: 3 to 4 parts in a thousand.
6[2] Reaction, distinctly alkaline.
1[3] Due to basic carbonate, and phosphate of soda in plasma.
2[3] Diminishes rapidly after blood is drawn. (*Zunte*).
7[2] Temperature, 98° to 100° F.
1[3] Deepest vessels have the warmest blood.
8[2] Gases of the blood.
1[3] Of arterial blood.
1[4] Oxygen, 20%.
2[4] Carbon dioxide, 50%.
3[4] Nitrogen, 2%.
2[3] Of venous blood.
1[4] Oxygen, 10%.
2[4] Carbon dioxide, 60%.
3[4] Nitrogen, 2%.
9[2] Histology of blood.
1[3] Parts.
1[4] Blood plasma: blood minus corpuscles.
1[5] Parts.
1[6] Serum: plasma minus fibrin.
1[7] Chemistry of.
1[8] Water, 90%.
2[8] Proteids, 8.5%.
1[9] *Serum albumin* the most abundant.
3[8] Fats, salts, and other less known bodies, 1.5%.
2[6] Fibrin factors.
1[7] Fibrinogen.
2[7] Fibrinoplastin.
3[7] Fibrin ferment.

2^{5} Corpuscles.
1^{5} Kinds.
1^{6} Red.
1^{7} Form: circular biconcave disks.
1^{8} Rouleaux.
2^{7} Size —$_{3500}$ to $_{3200}$ inch in transverse diameter.
1^{8} Larger only in sloth and elephant.
2^{8} Cause of seeming changes under a microscope.
3^{7} Shape.
1^{8} In Mammals, circular.
1^{9} Oval in llama and camel.
2^{8} In Birds, oval.
3^{8} In Reptiles, oval.
4^{8} In Amphibia as the frog and toad, oval.
5^{8} In Fishes, oval.
4^{7} Detection of the murderer because of variance in size and shape.
1^{8} Corpuscles of dog very much like that of Human.
5^{7} Specific gravity 1.088 to 1.105.
6^{7} Number: $_{25}$ cu. in., or drop of blood has 5000000 red corpuscles.
1^{8} 1 white to 1000 red in fasting.
2^{8} 1 white to 250 or 300 after a meal.
3^{8} A little less than one-half blood mass. (*Flint*).
7^{7} Color.
1^{8} Singly, yellow.
2^{8} In large number, red.
1^{9} Cause, different refraction and reflection.
3^{8} Coloring matter, haematin.
8^{7} Chief constituents.
1^{8} Haemoglobin, ($C^{1650}H^{960}N^{154}FeS^{3}O^{176}$).
1^{9} Its affinity for oxygen.
2^{9} Oxyhaemoglobin.
2^{8} Water and stroma.
9^{7} Function, to carry oxygen.
10^{7} Anoemia.
11^{7} Origin, unknown: probably *de novo*.

12⁷ No nucleus in red blood corpuscle of Mammals but present in red corpuscles of other vertebrates.

2⁶ White corpuscles or leucocytes.

1⁷ About $\frac{1}{300}$ of red.

2⁷ Capability of changing form—amoeboid movements.

3⁷ Found in lymph, chyle, pus, vitreous humor, etc.

1⁸ Chief constituent of pus.

4⁷ Diameter, one-third larger than red.

5⁷ Has a nucleus.

3⁶ Plaques; corpuscles of *Hayem or Olser*.

1⁷ Much smaller than red.

2⁷ Existence, only recently proved.

10⁵ Kinds of blood.

1⁵ Arterial. Not always of artery.

2⁵ Venous. Not always of vein.

11⁴ Coagulation of blood.

1⁵ Stages.

1⁴ First, gelatinization.

2⁴ Second, the collecting of blood serum.

3⁴ Third, the completion of clot.

2⁵ Cause.

1⁴ Formation and shrinking of fibrin threads.

1⁵ Corpuscles gathered up by them.

2⁵ How is fibrin formed?

1⁶ Blood has in it a proteid substance.

2⁶ Fibrin ferment forms in it by breaking up white or plaque corpuscles.

1⁷ Does not form part of clot.

3⁶ Coagulation facilitated by presence of fibrinoplastin.

4⁶ Coagulation prevented by *Epsom salts*.

3⁵ Injury to blood vessel or exposure causes more rapid coagulation.

4⁵ Lymph coagulates but not so firmly as blood.

3⁴ Whipped blood.

1⁴ How whipped?

2⁴ Color of pure fibrin threads.

4[3] Uses of coagulation.
1[4] Hemorrhages are arrested.
1[5] An aid to surgeons in ligatures, etc.
2[5] Cuts, etc., healed because of it.
5[3] Buffy coat on top formed because of oxygen of air.
6[3] Length of time after death till blood coagulates.
1[4] The corpuscles at bottom in coagulation after death.
1[5] Value in *medico-legal* cases. (*Martin*, H. B., p. 57).
12[2] Quantity of blood in Body.
1[3] $\frac{1}{5}$ to $\frac{1}{5}$ the weight of the Body.
13[2] Specific Gravity, 1.055.
14[2] Bacteria in blood.
4[1] Lymph and lymphatic vessels.
1 Histology of lymph.
1[3] Colorless watery looking liquid.
1[4] In lacteals, white milky.
2[3] Pale corpuscles in it and no red.
1[4] Why? Change of shape.
2[2] Renewal of lymph.
1[3] By dialysis or osmosis.
1[4] From blood-vessels.
2[4] From receptive organs.
2[3] Waste matter gathered up.
3[2] Specific gravity, about 1.045.
4[2] Movements of lymph.
1[3] Always toward heart.
1[4] Valves in vessels permitting no backward flow.
2[3] How caused?
1[4] Pressure.
1[5] From heart propulsion.
2[5] From heavier weight of blood.
1[6] Blood and lymph vessels being in contact.
3[5] By friction of outside objects.
4[5] By pressure from a natural working of Body, respiration, muscular energy, etc.
5[5] Contraction of muscular filaments in villi.
2[4] Suction power.

1⁵ Because of a sort of vacuum in heart and contact of lymph and blood-vessels.

2⁵ Because of vacuum produced in inspiration.

5² Lymphatic vessels.

1³ Origin.

1⁴ In areolar spaces, capillaries.

2⁴ In serous spaces, capillaries.

3⁴ In villi.

2³ Principal trunks formed.

1⁴ Right lymphatic duct.

1⁵ Collects lymph from right arm, right half of thorax and head.

2⁵ Lymph always clear in this.

3⁵ Empties into right innominate vein at junction of right subclavian and right jugular.

2⁴ Thoracic.

1⁵ Origin, *receptaculum chyli*.

2⁵ Gathers fluid from balance of Body, except that, that goes to right lymphatic duct.

3⁵ Empties into left innominate, at junction of left subclavian and left jugular.

3³ Where found.

1⁴ Almost all over the Body.

2⁴ Clustered more thickly in certain regions.

1⁵ In mesentery.

2⁵ In iliac plexus.

3⁵ In lumbar plexus.

4⁵ Over bronchi and elsewhere.

5⁵ In axilla of arm.

6⁵ Sides of neck.

4³ Structure.

1⁴ Three coats.

1⁵ Lining thrown into folds forming valves.

1⁶ Knotted exterior.

2⁵ Almost transparent.

5³ Classes in relation to lymphatic glands.

1⁴ Afferent.

2^4 Efferent.
6^3 Diameter $\frac{3}{100}$ inch at origin to $\frac{1}{8}$ inch.
7^3 Stomata opening into them.
6^2 Lymphatic glands, ganglia, or nodes.
1^3 Location.
1^4 In the track of blood-vessels,
2^3 Shape: roundish masses.
3^3 Where located?
1^4 Numerous in mesentery, groin, and neck.
1^5 "Waxing kernels" in neck.
4^3 Structure.
1^4 External capsule.
2^4 Framework of areola tissue.
3^4 Lymph corpuscles seem to multiply in them.

Blood { Plasma { Serum / Fibrin } / Corpuscles { Fibrinogen / Fibrinoplastin } } Clot.

NOTES:—

1. Corpuscle—Lat., *corpusculum*, diminutive of *corpus*, a body.
2. Haemoglobin—Gr., *aima*, blood, and (Eng.) globe.
3. Lymph—Lat., *lympha*, water.
4. Oxyhaemoglobin, from oxygen and haemoglobin.

1. Circulation.

1[1] Kinds of circulation, as to material.

1[2] Lymphatic circulation.

2[2] Blood circulation.

1[3] Discovered by Sir John Harvey, 1616.

2[3] Anatomy of blood circulation.

1[4] Organs of circulation.

1[5] Heart.

1[6] Position, in mediastinum.

1[7] In the chest cavity, just above diaphragm.

2[7] Base upwards, a little to right of sternum, from 4th to 8th dorsal vertebra.

3[7] Apex downward, a little to left of sternum, between 5th and 6th cartilages of left ribs.

4[7] Oblique. Mass, central.

1[8] Is the expression. "The left hand is nearest to the heart" right ?

2[6] Description.

1[7] Shape, conical.

1[8] With an apex and a base.

2[7] Membranes of the heart.

1[8] Heart surrounded by a loose bag called pericardium.

1[9] Shape, conical, but turned in opposite direction to the heart.

2[9] Layers.

1[10] Parietal, a loose sack.

2[10] Visceral, covering heart closely.

3[9] Serous or pericardial fluid secreted by serous membrane between the two layers.

4[9] Pericarditis.

1[10] Use of stethoscope.

2[10] Occurs in rheumatic fever.

3[10] Necessity of great care.

2[8] Endocardium lining cavities of heart and extending some distance into blood-vessels.

3[7] Size.

1[8] Length about 5 inches.

2[8] Thickness 2½ to 3½ inches.

4[7] Weight 10 to 12 ounces in male, 8 to 10 in female.

5[7] Divisions.

1[8] Into right and left sides by median septum.

1[9] Each divided into auricle and ventricle by auriculo-ventricular septum.

1[10] Auricles at base,—"feed pumps."

1[11] Origin of name, and function.

2[11] Right auricle larger than left. (⅛ to ¼).

3[11] Right auricle.

1[12] Openings.

1[13] Mouth of superior or descending vena cava.

2[13] Mouth of inferior or ascending vena cava.

1[14] Eustachian valve at mouth at early age.

1[15] Purpose to direct blood through foramen ovale before birth.

3[13] Mouth of coronary sinus, returning blood from heart itself.

1[14] A valve at opening.

4[13] Mouth of *Foramina Thebesii*. The mouth of veins returning blood from substance of heart itself.

5[13] Foramen ovale, opening between auricles before birth.

1[14] Fossa ovalis its remnant, annulus ovalis the raised border around it.

6[13] Auriculo-ventricular orifice.

4[11] Left auricle.

1[12] Mouths of pulmonary veins. 4.

1[13] Two from each lung.

2[13] Two from left lung.

3[13] No valves.

2[12] Foramen ovale.

3[12] Auriculo-ventricular.

5[11] Columnae carnae in auricles proper.

2[10] Ventricles, body and apex—"force pumps."

1^{11} Right $\frac{1}{10}$ to $\frac{1}{8}$ larger than left.

2^{11} Right ventricle.

1^{12} Openings.

1^{13} Auriculo-ventricular orifice.

1^{13} Of pulmonary artery, carrying blood to lungs.

2^{12} Valves.

1^{13} Tricuspid at auriculo-ventricular orifice.

1^{14} Attachments, *chordae tendineae*.

1^{15} Attached to papillary muscles at lower end.

2^{15} Papillary muscle located on columnae carnae.

1^{16} Columnae carnae located all through.

2^{14} Purpose.

2^{13} Semilunar or sigmoid prevent return of blood from pulmonary artery.

1^{14} Corpora Arantii, cartilaginous nodules on edges.

2^{14} Sinuses of Valsalva behind valves.

3^{11} Left ventricle.

1^{12} Openings.

1^{13} Auriculo-ventricular orifice.

2^{13} Aortic.

2^{12} Valves.

1^{13} Mitral or bicuspid at auriculo-ventricular opening.

1^{14} Attachments, *chordae tendineae*.

1^{15} Papillary muscles at lower end.

1^{16} Columnae carnae beneath them and all over lining of ventricle.

2^{14} Purpose.

2^{13} Semilunar or sigmoid guarding aortic opening.

1^{13} Sinuses of Valsalva and corpora Arantii.

4^{11} Shape, conoidal-triangular.

1^{12} Right shorter and broader than left.

6[7] Structure.

1[8] Muscular.

1[9] Of auricles, two layers.

2[9] Of ventricles, two layers.

3[9] Right side much thinner walled than left. Why?

4[9] No sarcolemma.

7[7] Movements of heart.

1[8] Systole: auricular and ventricular.

2[8] Diastole: auricular and ventricular.

3[8] Pause: peri-systole.

8[7] Blood vessels supplying blood.

1[8] Coronary arteries, right and left.

9[7] Beats.—The pulse.

1[8] About 70 per minute.

1[9] Varies with.

1[10] Age. Become less frequent in age increase.

2[10] Sex. Generally more rapid in female.

3[10] Muscular activity.

4[10] Conditions of digestive organs.

5[10] Temperature.

6[10] Posture and respirations.

7[10] Disease.

10[7] Nerves of heart.

1[8] Controlled by ganglia located in heart wall: (*intrinsic ganglia*).

2[8] Increased or decreased by other nerves leading to it.

1[9] By the pneumogastric cranial nerves.

1[10] Effect of kick in stomach or introduction of very cold water, on the heart beat.

2[9] By sympathetic nervous system.

2[5] Arteries. *

1[6] Why so called?

2[6] Always come from heart or branch.

3[6] Anostomoses of arteries. Collateral circulation.

4[6] Classification.

1[7] From left ventricle.

1[8] Aorta.
1[9] Semilunar valves at beginning.
2[9] Divisions and branches.
1[10] Arch of aorta.
1[11] Ascending portion.
1[12] Branches right and left coronary arteries.
1[13] Blood flow in these caused more by a backward flow in aorta.
2[11] Transverse portion.
1[12] Branches in order.
1[13] Innominate, to right.
1[14] Divides opposite sterno-clavicular articulation.
2[14] Right subclavian.
1[15] R. vertebral passes along spine and goes to brain.
2[15] R. axillary in arm pit, continuation of subclavian.
1[16] R. brachial, continuation of axillary: (humeral).
1[17] R. radial, thumb side; pulse.
1[18] Palmar arch and digital.
2[17] R. ulnar, little finger side.
1[18] Palmar arch and digital.
2[14] Right common carotid.
1[15] Internal right to the brain.
2[15] External—face.
1[16] R. temporal, a very tortuous division.
2[13] Left common carotid.

*It is a good plan to require pupils to make a diagram of the blood circulation, naming parts by means of reference figures. I would urge teachers to have their pupils draw as many good figures of the different parts of the Body as possible. Nothing outside of the real object, is of so much value to the pupil as a concrete illustration as a good picture that he has learned to draw well. The picture gives the teacher an excellent idea of the pupil's idea, and requires of the pupil the highest powers of attention. Cross sections of the eye, ear, brain, heart and trunk should receive special attention. There is a tendency in pupils to dismiss it, but the teacher should insist on its being done. Good pictures as models can be found in any good text-book.

1^{14} Internal left to the brain.

2^{14} External left to the face.

1^{15} Left temporal.

3^{13} Left subclavian.

1^{14} L. vertebral, passing along spine to brain.

2^{14} Left axillary, continuation of L. subclavian.

1^{15} L. brachial, continuation of L. axillary, (humeral).

1^{16} L. radial.

1^{17} Palmar arch, and digital.

2^{16} L. ulnar..

1^{17} Palmar arch, and digital.

3^{11} Descending.

2^{10} Thoracic aorta.

1^{11} Bronchial—two.

1^{12} Bronchi and lungs.

2^{11} Oesophageal, 3 or 4 in number, for oesophagus.

3^{11} Pericardial. Back part of pèricardium.

4^{11} Intercostal, 10 pairs.

5^{11} Posterior mediastinal.

3^{10} Abdominal aorta.

1^{11} Caeliac axis.

1^{12} Coronary.

1^{13} Oesophageal, lower end of oesophagus.

2^{13} Gastric for stomach.

2^{12} Hepatic, to liver.

1^{13} Branches.

1^{14} Cystic, to gall bladder.

2^{14} Pyloric, to stomach.

3^{14} Gastro-duodenal branch.

1^{15} Divisions.

1^{16} Superior pancreatico-duodenal, for pancreas and duodenum.

2^{16} Right gastro-epiploic, for stomach and omentum.

3^{12} Splenic, ends in spleen.

1^{13} Branches given off.

1^{14} Pancreatic branches, to pancreas.

2^{14} Vasa brevia to great end of stomach.

3^{14} Left gastro-epiploic, to stomach and omentum.

2^{11} Superior mesenteric artery.

1^{12} Inferior pancreatico-duodenal, pancreas and duodenum.

2^{12} Twelve intestinal to small intestines.

3^{t} Ileo-colic, ileum, cæcum, and colon.

4^{12} Right-colic, ascending colon.

5^{12} Middle-colic, transverse colon.

3^{t1} Inferior mesenteric.

1^{12} Left colic, descending colon.

2^{12} Sigmoid, sigmoid flexure.

3^{12} Superior hemorrhoidal, rectum.

4^{11} Capsular, supra renal capsules—two.

5^{11} Renal, kidneys—two.

6^{11} Spermatic or ovarian—two.

7^{11} Lumbar, lumbar and abdominal walls—4 pairs.

8^{11} Phrenic, lower part of diaphragm.

9^{11} Middle sacral or *sacra media*, continuation of abdominal aorta.

1^{12} Very long in animals having a long tail.

10^{11} Common iliacs, right and left.

1^{12} Internal iliac, pelvis.

2^{12} External iliac.

1^{13} Femoral artery, beyond Poupart's ligament, a continuation of iliac.

1^{14} Profunda or deep branch.

2^{13} Popliteal, continuation of femoral.

1^{14} Anterior tibial, front part of leg.

1^{15} Plantar and digital.

2^{14} Posterior tibial.

1^{15} Peroneal.

2^{15} Plantar and digital.

2^{7} From right ventricle.

1[8] Pulmonary artery 1¾ inches long.
1[9] Divisions.
1[10] Right, to right lung.
2[10] Left, to left lung.
2[9] Valves at ventricle, semilunar.
3[9] Venous blood in it.
5[6] Structure.
1[7] Coats from without.
1[8] External, cellular, or *tunica adventitia*.
2[8] Middle, muscular or fibrous circular coat.
1[9] Vaso-motor nerves go to them.
2[9] Effect in modifying blood flow.
3[8] Internal serous or epithelial coat.
1[9] A sort of continuation of endocardium.
7[6] Nourished by blood vessels known as *vasa vasorum* and not by blood in arteries.
1[7] Found in middle and external coats.
8[6] Usual mode of division.
1[7] Dichotomous.
3[5] Veins.
1[6] Purpose to carry blood to heart.
2[6] Classes.
1[7] As to depth.
1[8] Deep or venae comites.
1[9] Generally have name of artery accompanied.
2[8] Superficial.
3[8] Sinuses in skull between layers of dura mater. only.
2[7] As to part of system.
1[8] Systemic.
2[8] Pulmonic.
3[6] Principal trunks.
1[7] Systemic, for right auricle.
1[8] Ascending or inferior vena cava. Lower part of Body including part of thorax.
1[9] Branches and subbranches leading to it, beginning with lowest.

1^{10} Common iliacs, right and left.
1^{11} Internal.
2^{11} External, continuation of femoral.
1^{12} Femoral, continuation of popliteal.
1^{13} Long saphenous joins it, a superficial vein.
2^{13} Profunda recieved.
3^{13} Popliteal at knees.
1^{14} External saphenous, empties into it.
2^{14} Formed by.
1^{15} Anterior tibial.
2^{15} Posterior tibial.
1^{16} Plantar, principally empty into this.
2^{10} Renal, two.
3^{10} Hepatic vein.
1^{11} Hepatic veins, three in number from liver form it.
1^{12} Capillaries of portal circulation.
1^{13} Portal vein.
1^{14} Gastric.
2^{14} Splenic.
3^{14} Superior mesenteric.
4^{14} Inferior mesenteric.
4^{10} Oesophageal.
5^{10} Pericardial.
2^{8} Descending or superior vena cava.
1^{9} Formed by two innominate veins.
1^{10} Divisions forming innominates.
1^{11} Jugular, right and left.
1^{12} External.
2^{12} Internal.
2^{11} Subclavian, right and left, continuation of axillary.
1^{12} Axillary.
1^{13} Superficial branches forming it.
1^{14} Basilic.
2^{14} Cephalic. Bleeding patients.
1^{15} Radial, ulnar, and median make up 1^{14} and 2^{14}.

1[16] Formed by digital.

2[16] Lymphatic ducts enter at junction of jugular and subclavian.

2[7] Pulmonic or pulmonary, 4 in number.

1[8] Lungs to left auricle.

4[6] Valves.

1[7] Arteries possess no valves except at origin but veins do.

2[7] Made up of one, two, or three pouches.

5[6] Structure.

1[7] Coats.

1[8] Inner, thins down.

2[8] Middle, thins down.

3[8] Outer or external, remains thick.

4[5] Capillaries.

1[6] Connect arteries to veins at distal part.

1[7] Veins to veins in portal circulation.

2[7] Arterioles and veinlets.

2[6] Found in nearly all parts of the Body.

3[6] Kinds.

1[7] Pulmonic.

2[7] Systemic.

1[8] Great place of building up tissues.

4[6] Number innumerable.

5[6] Uses of.

1[7] Places blood in contact with tissues so that they can be built up.

2[7] Permits waste matter to dialyze into the blood and hence carried to excretory organs.

3[7] The final place of consumption and exchange.

6[6] Size—$\frac{1}{1500}$ inch in diameter. (From $\frac{1}{3500}$ inch on up).

7[6] Structure.

1[7] Only inner coat of arteries and veins remain behind, with a sort of a remnant of outer.

8[6] Capillary circulation.

2[4] How treat wounds and excessive bleeding?

1[5] The stopping of blood flow.

2^5 The meeting of parts and healing.

3^3 Kinds of circulation of blood.

1^4 Pulmonic or lesser.

1^6 Heart to heart through lungs.

2^5 Pulmonary arteries, veins, and capillaries.

2^4 Systemic or greater.

1^5 Systemic proper.

2^5 Portal.

1^6 Blood goes through three sets of capillaries.

3^5 Coronary.

1^6 Heart substance itself.

4^3 Rate of circulation of blood.

1^4 In arteries.

1^5 Varies, (about 16 inches per second).

2^5 Pulse.

1^6 What might be learned from it?

1^7 Nature of health and disease.

2^6 Caused by heart beat.

1^7 About 70 beats per minute.

3^6 An intermittent flow.

2^4 In capillaries, $\frac{1}{50}$ to $\frac{1}{30}$ inch per second.

1^5 Slowest. Why?

2^5 Frogs web in its foot.

3^5 A continuous flow.

4^4 Varying conditions, modifying blood flow.

1^5 Age.

2^5 Position.

3^5 Temperature.

4^5 Condition of health of Body.

5^5 Relative activity of Body.

6^5 Friction in vessel.

7^4 The vessel itself.

8^5 Activity of heart.

5^4 General average of entire circuit rate 23 seconds. *

1^5 Not well determined.

5^3 Causes of circulation of blood.

1^4 Primary.

1[5] Systole of heart.

2[4] Secondary.

1[5] Gravity.

2[5] Compression of arteries and veins.

3[5] Aspiration of thorax and general compression.

6[3] Proofs of circulation.

1[4] Blood injected into an artery of dead Body will return by a vein.

2[4] Valve arrangement of heart and veins show it.

3[4] Cut artery spurts from heart end, and cut vein bleeds most from end farthest from heart.

6[4] Vein emptied fills from distal end.

5[4] Vein gorged on distal side of bandage and emptied on proximal side.

6[4] Observations in lower animals by microscope proves it for them.

*1. Rate in other animals for circuit:

1[4] The Horse, 27.3 seconds.

2[4] The Dog, 15.2 seconds.

3[4] The Goat, 12.8 seconds.

4[4] The Rabbit, 6.9 seconds.

7[3] Work of heart.

1[4] Rate of normal beat 70 per minute.

1[5] Heart beat varies according to age and other conditions.

2[4] Amount of blood thrown out each beat, 12.6 ounces.

1[5] From each ventricle 6.3 ounces.

3[4] Blood as a whole moved on. $\frac{1}{5}$ weight of Body.

1[5] About 23 seconds required for circuit.

4[4] Total work about 434112 foot-pounds for one day.

8[3] Classes of nerves as to function.

1[4] Vaso-dilator.

2[4] Vaso-motor.

3[4] Accelerator or vaso-constrictors.

4[4] Cardio-inhibitory.

5[4] Depressor.

9[3] Sounds of heart: *lubb, dup.*

1⁴ First, probably because of ventricular contraction.

2⁴ Second, because of closing of semilunar valves.

3⁴ Variations of sound in heart disease.

10³ Arterial pressure, dependent on.

1⁴ Rate of heart's beat.

2⁹ Quantity of blood forced into arteries at each beat.

3⁴ Calibre of smaller vessels.

4⁴ Controlled by nervous system.

11³ Taking cold.

1⁴ Effect of cold striking skin.

1⁵ More blood thrown inward.

2⁵ Blood pressure within raised, hence "congestion."

1⁶ Catarrh.

2⁶ Diarrhoea.

3⁶ Bronchitis.

4⁶ Summer complaint.

3⁵ Temperature lowered.

2⁴ Kinds of baths to take.

12³ Cause of dizziness, lack of blood in head.

1⁴ Why lay down?

NOTES:—

1. Auricle—Lat., *auricula*, diminutive of *auris*, an ear: because flaps resemble a dog's ear.
2. Aorta—Gr., *aeirein*, to lift.
3. Artery—Lat., *arteria*, windpipe. It was originally believed to be an air tube.
4. Anastomose—*anastomoun*, to furnish with a mouth.
5. Axillary—Lat., *axilla*, the armpit.
6. Bicuspid—Lat., *bis*, twice, and *cuspis*, a point.
7. Brachial—Lat., *brachium*, the arm.
8. Columnae carnae—Lat., *columna*, a column, and *caro, carnis*, flesh: fleshy columns.
9. Chordae tendineae—Lat., *chorda*, a cord, and *tendineae*, tendinous.
10. Cephalic—Gr., *cephale*, the head.
11. Carotid—Gr., *kara*, the head.
12. Capillary—Lat., *capillus*, a hair.
13. Caeliac—Gr., *koilia*, the hollow of the belly.
14. Coronary—Lat., *coronarius*, referring to a crown.
15. Diastole—Gr., *dia*, through, and *stellein*, to place.
16. Endocardium—Gr., *endon*, within, and *kardia*, the heart.
17. Hepatic—Gr., *hepar*, the liver.
18. Hemorrhoidal—veins likely to discharge blood in piles.

19. Innominate—Lat., *in*, not, and *nominare*, to name.
20. Jugular—Lat., *jugulum*, the collar bone.
21. Mediastinum—Lat., *medius*, the middle.
22. Pericardium—Gr., *peri* around, and *kardia*, the heart.
23. Parietal—Lat., *paries*, a wall.
24. Pulmonary—Lat., *pulmo*, *pulmonis*, the lung.
25. Popliteal—Lat., *poples*, *poplitis*, the ham.
26. Phrenic—Gr., *phrenos*, the midriff or diaphragm.
27. Palmar—Lat., *palma*, the palm of the hand.
28. Profunda—Lat., *pro*, before, and *fundus*, the bottom.
29. Peroneal—Gr., *perone*, the fibula.
30. Renal—Lat., *renes*, the kidneys.
31. Semilunar—Lat., *semi*, half, and *lunar*, moon like.
32. Systole—Gr., *systellein*, to contract.
33. Sinus—a little elongated cavity.
34. Sigmoid—Gr., *sigma*, a Greek letter, and *edios*, form.
35. Tricuspid—Lat., *tri*, three, and *cuspis*, a point.
36. Ventricle—Lat., diminutive of *venter*, the belly.
37. Vaso—Lat., *vaso*, *vasum*, a vessel.

1. Respiration.

1[1] Objects or functions of it.

1[2] To supply oxygen waste of Body.

1[3] Oxidation must occur if energy be liberated.

2[3] No oxidation occurs without oxygen.

2[2] To throw off deleterious matter and torn down tissues.

1[3] Chief wastes thrown off.

1[4] Carbon dioxide. CO^2.

1[5] Formed by oxygen and carbon, by oxidation.

2[1] Volatile poisons.

1[5] The deleterious matter in breathed air.

3[1] Effete animal matter.

1[5] Germs of disease carried into the air through it.

2[3] Other waste products, urea, uric acid, etc.

3[3] Water, and other non-ozidizable substances.

3[2] To change venous to arterial blood.

4[2] To test the general purity because of the introduction of substances to olfactory nerve.

1[3] Bad atmosphere noticeable by a relaxation of constitutional strength.

5[2] To prevent and banish disease.

6[2] Regulator of temperature and moisture.

2[1] Definition. The process by which various tissues or organs receive and appropriate oxygen.

3[1] Kinds.

1[2] Internal.

1[3] In systemic capillaries.

1[4] Agent, haemoglobin of blood.

2[2] External.

1[3] In lungs.

2[3] Usually meant by respiration.

4[1] Organs of respiration.

1[2] In very small animals as in amoeba, hydras, and larger.

1[3] No special division between internal and external respiration.

2 In insects, or tracheal breathers.

1[3] No necessity for blood: tubes or spiracles leading in.

3[2] In fishes or aquatic animals in general.

1[3] Gills serve as special respiratory organs.

1[4] 100 volumes of air can possess 3 volumes of oxygen.

4[2] In frogs—lungs and skin.

1[3] Why does frog not remain longer under water ?

5[2] In larger land animals in general.

1[3] Lungs, some through the skin.

6[2] In man.

1[3] Regular respiratory organs.

1[4] Air passages, in order, from without.

1[5] Nostrils or mouth and fauces.

2[5] Pharynx.

1[6] Openings, 7.

3[5] Glottis.

1[6] Covering epiglottis.

1[7] A triangular, spoon-shaped cartilaginous lid.

2[6] Opening into larynx.

3[6] Vocal cords at opening.

1[7] Pairs, two.

1[8] False, only imitations.

2[8] True, the real cords.

1[9] Very thin and capable of being brought close together by muscles of thyroid and arytenoid cartilages.

2[9] Voice produced by air being compelled to pass through narrow aperture between them and vibrations of cords.

1[10] Sound of voice strengthened by resonating in cavities around cord and force of expulsion of air.

2[10] Pitch of voice dependent on thickness, length and tensity of cords hence upon number of vibrations.

1[11] Range of voice.

1[12] Lowest ordinary bass 88 vibrations.

2[12] Highest ordinary soprano 792 vibrations.

3[12] Great range known 55 to 2114 vibrations.

4^{12} Range per individual about three octaves.

3^{10} Production of different sounds by modification.

4^{10} "Falsetto voice."

5^{10} Training the voice.

6^{10} Hoarseness due to inflamed cords.

3^{9} Speech. Modified voice.

1^{10} Modifying organs.

1^{11} Lips, tongue, teeth, palate, nose, pharynx, etc.

2^{10} Edison's phonograph.

4^{5} Larynx, the "voice box."

1^{6} Location, upper part of neck in front of pharynx, above trachea.

2^{6} Structure.

1^{7} Lining, mucous membrane.

2^{7} Fibrous tube.

1^{8} Cartilages surrounding it and keeping it open.

1^{9} Thyroid in front. "Adam's apple."

1^{10} Attached to hyoid bone.

2^{9} Epiglottis.

3^{9} Arytenoid, two, and others of less importance.

3^{6} Thyroid gland attached to lower part of larynx.

1^{7} Of no physiological interest.

5^{5} Trachea.

1^{6} Position in front of oesophagus.

2^{6} Structure.

1^{7} Lining, mucous membrane covered by several epitheliel cell layers.

2^{7} Fibro-cartilaginous tube.

1^{8} Imbedded cartilages in shape of horse-shoe.

1^{9} 16 to 20 in number. (*Flint*).

2^{9} Cartilages, opening dorsally at oesophagus.

1^{10} Probable positive value in swallowing.

3^{7} Serous coat covering it in thorax.

6^{5} Bronchi.

1^{6} Right, and left.

2^{6} Structure same as trachea, only cartilages might be turned either way.

7⁵ Bronchial tubes.
1⁶ Walls become thinner.
8⁵ Bronchioles.
9⁵ Air cells, alveoli, or air vesicles. *
1⁶ Lined only by epithelium, and some elastic tissue.
2⁶ Diameter $\frac{1}{150}$, $\frac{1}{120}$, to $\frac{1}{70}$ inch, but capable of being distended.
3⁶ Pulmonary capillaries near by and interchange.
10⁵ Ciliated cells found in all air passages.
1⁶ Cilia especially prominent in trachea.
1⁷ Their fanning movement outward.
1⁸ Material "hawked" up. Value of coughing.
2⁴ Lungs. A scavenger. † (Lights of vulgar).
1⁵ Structure.
1⁶ Bronchial tubes, bronchioles, and air cells found in it.
2⁶ Blood vessels.
1⁷ Pulmonary arteries, capillaries, and veins.
1⁸ Pulmonary artery has venous blood and pulmonary vein arterial blood.
2⁷ Osmotic exchange of blood material for material of air: principally CO^2 for O.
3⁶ Tissue, cellular: parenchyma.
1⁷ Very light, elastic, and sort of cartilaginous.
4⁶ Lymphatics in it.
5⁶ Covering of lungs, pleura.
1⁷ Layers.
1⁸ Parietal, lining thorax.
2⁸ Visceral, covering lung tissue.
2⁷ Serous fluid secreted between them and value.
3⁷ Pleurisy, inflammation of pleura.

*1. Surface of air cells.
1¹ 2600 square feet. (*Martin*)
2¹ 289 square feet. (*Hales*).
3¹ 152 square feet. (*Keill*).
4¹ 1500 square feet. (*Lieberkuhn*).
5¹ 60 square feet. (*Jenkins*).

†1. The other scavengers are the kidneys and skin.

2[5] Divisions, right and left lung.
1[6] Right.
1[7] Largest of the two.
1[8] Broader and shorter.
1[9] Shorter because diaphragm extends highest on that side.
2[7] Lobes—three.
1[8] Lobules and finally alveoli.
1[9] Close contact of capillaries and blood.
2[6] Left.
1[7] Lobes—two.
1[8] Lobules and finally alveoli.
1[9] Closeness of capillaries and blood.
3[6] Separated by mediastinum.
3[5] Elasticity remarkable.
4[5] Nerves, pneumogastric.
5[5] How do lungs remain expanded?
1[9] Air tight chest cavity enlarged.
2[6] Weight of air at sea level, 15 lbs. to sq. in.
1[7] Elastic lungs expanded by weight.
6[6] Capacity of lungs of man 5 ft. 8 in. high.
1[6] After forced inspiration, 328 cu. in.
1[7] Increases for every inch of stature 9 cu. in.
2[6] Amount left in lungs after ordinary expiration, 200 cu. in.
1[7] Residual air, always remaining in lungs, 100 cu. in.
2[7] Supplemental air, may be forced out, 100 cu. in.
3[6] Tidal air, ordinarily inspired, 30 cu. in.
4[6] Complemental air, forcibly inspired, 98 cu. in.
5[6] Vital capacity of lungs 100+100+30=230 cu. in.
3[4] Thorax.
1[5] Parts of thorax.
1[6] Air tight space.
2[6] Thoracic viscera and especially hollow lungs, etc., located in it.
3[6] Thoracic wall.
1[7] Structure of thoracic wall.

1[8] Skeletal or bony part.
1[9] Ribs, sternum, spinal column, clavicle, cartilages, and possibly scapula.
2[8] Fleshy part.
1[9] Ordinary muscles used in inspiration.
1[10] Scalene, anterior, middle, and posterior.
2[10] Intercostales, external, and internal.
3[10] Diaphragm.
1[11] Curved upward, conical.
4[10] Serratus posticus superior.
5[10] Serratus magnus.
6[10] Pectoralis major and minor.
7[10] Trapezius, and twelve levator costarum, etc.
2[9] Muscles used for forced expiration.
1[10] Internal intercostales.
2[10] Obliquus externus and internus.
3[10] Infracostales.
2[5] Boundary.
3[5] Changes in capacity. Why? Explain.
1[6] Dorso-ventral.
2[6] Lateral.
3[6] Vertical.
4[5] Cause of abdominal movement in breathing.
4[4] Pulmonary arteries, veins, and capillaries.
5[1] Nerves controlling respiration.
1[2] Pneumogastric to lungs.
2[2] Dorsal spinal nerves or intercostales.
3 Phrenic, to diaphragm.
4[2] Respiratory center in medulla oblongata.
1[3] Destruction of, causes respiration to cease at once and produces death.
6[1] Respiratory movements.
1[2] Classes.
1[3] Inspiration.
2[3] Expiration.
2[2] Effect on lymph flow.
1[3] Intra-thoracic pressure lowered and abdominal press-

ure increased in inspiration forces lymph upward.

2[3] Valves prevent a backward flow.

3[3] Expiratory act presses on lymph in thorax but can not flow backward.

3[2] Effect on blood flow.

1[3] Causes blood to be "sucked" into right auricle because of a lack of intra-thoracic pressure.

2[3] Expiration tends to expel blood.

3[3] Lungs distending, opposing heart action.

7[1] Types of respiration.

1[2] Abdominal.

1[3] Diaphragm a great factor and abdominal movement.

2[3] Most marked in children below three.

2[2] Inferior costal, from seventh rib on down.

3[2] Superior costal, above seventh rib.

1[3] Most prominent in female adult. Deleterious effects of corset wearing.

8[1] Frequency of respirations.

1[2] About fifteen or twenty times per minute.

2[2] About one for every four beats of heart.

3[2] Circumstances altering it.

1[3] Age.

2[3] Temperature.

3[3] Exercise.

4[3] Mental condition and habit.

5[3] Temperament, etc.

9[1] Sounds in respiration.

1[2] Ordinary sounds only noticed by stethoscope.

1[3] A soft breezy murmur in nostril breathing, tubular sound within.

2[2] Snoring: Only possible when mouth is open.

3[2] Very much modified in disease. Value of auscultation.

10[1] How is air received into lungs?

1[2] By enlargement of thorax.

2[2] By weight of air pushing itself down.

3[2] By transfusion, poor air is hurried inward into lungs.

11[1] Chemistry of respiration.

1² Objects investigated.
1³ Kinds and extent of interchanges of air and blood in lungs: (*external respiration*).
1⁴ Oxygen carried in.
2⁴ Things carried out.
1⁵ Carbon dioxide.
2⁵ Water.
3⁵ Organic and effete matters.
4⁵ Urea, uric acid, etc.
2³ Nature and amount of exchanges of blood and air in systemic capillaries: (*internal respiration*).
1⁴ More oxygen given off in lungs during the day, and at night less, in the carbon dioxide than is received from air. (*Martin*).
1⁵ Some cutaneous respiration and some introduction in foods eaten.
2⁴ All waste matter, etc., principally produced here. Great point of oxidation.
3⁴ Loss of external respiration a gain to the internal and *vice versa*.
2² Changes produced in air once breathed.
1³ In air.
1⁴ Chemical composition of.
1⁵ Pure dry air.
1⁶ Oxygen by vol. 20.8%, by weight 23%.
2⁶ Nitrogen by vol. 79.2%, by weight 77%.
2⁵ Expired air. Only 98.9% dry air received out of 100%.
1⁶ Oxygen 15.4% by volume.
2⁶ Nitrogen 79.2% by volume.
3⁶ Carbon dioxide 4.3% by volume.
4⁶ Substances making up additional matter.
1⁷ Volatile organic substances.
1⁸ Readily detected in a room ill ventilated and inhabited.
2⁷ Water.
1⁸ Dependent on condition of atmosphere.
3⁷ Sometimes loses nitrogen.
4⁷ Urea, uric acid, etc., passed off.

2⁴ Temperature.

1⁵ Air breathed generally cooler than that expired.

1⁶ Inspired about 70° F., and expired 97° F.

2⁵ The warmer the inspired air less loss.

3⁵ More moisture taken up by air expired generally than that inspired.

2³ In blood.

1⁴ Arterial blood changed to venous.

2⁴ Loss to air is gain to blood and gain to air is loss to blood.

3⁴ Dark-red haemoglobin changed to bright-red oxy-haemoglobin.

4⁴ Laws of absorption of gases by a liquid.

1⁵ A given volume of liquid exposed to a gas, if it absorbs any gas and does not chemically combine with it, takes up a definite volume of the gas.

2⁵ Amount of gas dissolved dependent not on the total pressure of combined gases but upon the fraction of pressure by the particular gas in question.

3⁵ A liquid may be such as to combine chemically with a gas.

4⁵ Bodies are known that chemically combine with certain gases if pressure is considerable.

5⁵ A membrane moistened by a liquid in which that gas is soluble does not essentially alter the laws of absorption.

5⁴ Blood gases.

1⁵ Kinds.

1⁶ Oxygen.

2⁶ Carbon dioxide.

3⁶ Nitrogen.

2⁵ Amount given off in normal pressure and normal temperature in vacuum, 72%.

1⁶ Venous blood.

1⁷ Oxygen, ... 10%.

2⁷ Carbon dioxide, ... 60%.

3⁷ Nitrogen, ... 2%.

2[6] Arterial blood.

1[7] Oxygen.....20%.

2[7] Carbon dioxide.....50%.

3[7] Nitrogen.....2%.

3[2] Ventilation.

1[3] 4.3% vitiated by being once breathed.

2[3] 800 cu. feet required to start with for each person.

1[4] One cu. ft. of a renewal per minute for each person.

1[5] Five times the amount would be better.

3[3] A fire in room, if proper ingress, is effective in keeping up circulation of air.

4[3] Fires and lamps burning deleterious if no supply be sent in.

1[4] No draught necessary.

1[5] How arrange openings?

5[3] Carbon dioxide not deleterious as volatile poisons.

1[4] Blood can take oxygen from minimum supply.

6[3] Value of properly constructed dwellings, churches and school-houses.

12[1] Nervous factors of the respiratory mechanism.

1[2] Normal respiratory movements are reflex.

1[3] Greater or less venosity of blood the stimulant.

1[4] *Dyspnoea*, violent labored respiration.

2[4] Eupnoea, normal quiet breathing.

3[4] Apnoea, the deathless quiet condition worse than dyspnoea.

2[2] Pneumogastric nerves modify movement.

1[3] Makes respiratory mechanism self-regulating.

13[1] Asphyxia.

1[2] How produced?

1[3] By strangulation.

1[4] Drowning, hanging, etc.

2[3] Exposure in air containing no oxygen.

1[4] A vacuum or only absence of oxygen.

3[3] Breathing air possessing gas possessing stronger affinity for haemoglobin than oxygen.

1[4] Example, carbon monoxide.

1⁵ French mode of suicide, burning of charcoal in open stove and closed room.

2² Stages of.

1³ Dyspnoea.

2³ Convulsions.

3² Exhaustion.

3² How resuscitate persons asphyxiated?

1³ Clear air passages.

2³ Set up artificial respiration.

4² Circulatory changes in asphyxia.

1³ Heart at first beats quicker and afterwards slower.

14¹ Amount of air breathed daily.

1² One respiration calls for 30 cu. in.

2² 15 respirations or one minute calls for 15X30 cu. in.=450 cu. in.

3² 60 min. or 1 hr. calls for 60X450 cu. in.=2700 cu. in.

4² 1 da. or 24 hrs. calls for 24X2700 cu. in=648000 cu. in.

15¹ Foreign substances in air breathed.

1² Dust, poison, germs of disease and bacteria, gases from cesspools and sewers, poisons in paints, etc.

16¹ Modified respiratory movements.

1² Sighing, yawning, hiccough, coughing, sneezing, laughing, and crying.

1³ What do each indicate?

2³ Distinguish laughing and crying.

3¹ Coughing and laughing caused by violent inspiration followed by violent expiration, coughing through mouth and sneezing through nose.

NOTES.—

1. Arytenoid—Gr., *arytaina*, a ladle.
2. Asphyxia—Gr., *a.* not, and *sphyxein*, to throb or beat.
3. Alveoli—Lat., *alveolus*, diminutive of *alveus*, a hollow, deep vessel.
4. Bronchi—Gr., *bronchos*, windpipe.
5. Diaphragm—Gr., *dia*, through, and *phrattein*, to fence.
6. Infracostales—Lat., *infra*, beneath, and *costa*, the rib.
7. Parietal—Lat., *paries*, a wall.
8. Respiration—Lat., *re*, again, and *spirare*, to breathe.
9. Vesicle—Lat., diminutive of *vesica*, a bladder.
10. Viscera—Lat., *viscus*, one of the organs of the great cavities of the Body.

1. Kidneys and Skin, (two of three scavengers).

1[1] Nitrogen excreting or urinary system.
1[2] Organs of.
1[3] Kidneys.
1[4] Location.
1[5] From eleventh or twelfth ribs to ilium.
2[5] Beneath peritoneum, concavity turned inwardly.
2[4] Shape—bean like.
3[4] Weight—4 to 6 ounces.
1[5] Left nearly always heavier than right.
2[5] Usually one-half ounce less in female.
4[4] Covering.
1[5] Fibrous coat, closely adherent.
2[5] Adipose coat, fatty covering.
5[4] Connection with circulatory system.
1[5] Renal arteries—2.
2[5] Renal veins—2.
6[4] Connection with bladder—ureters.
7[4] Naked eye or general structure.
1[5] Color, red-brown.
2[5] Capsule of peritoneum covering it, transparent.
3[5] Hilus, depression in concave border.
1[6] Pelvis within it, a widening out of ureter.
1[7] Cups or calices leading from it.
2[6] Division of renal arteries and veins within.
4[5] Parts.
1[6] Cortical portion.
1[7] Color, redder than medullary portion.
2[7] More granular than medullary portion.
3[7] Ultimate division of renal arteries and veins in it.
2[6] Medullary portion.
1[7] Less red than cortical.
2[7] Finely striated in radial direction.
3[7] Pyramids of Malpighi.
1[8] Separated by upward prolongations of cortical portion.
2[8] Papilla, the calyx of ureter at end of pyramid of Malpighi.

3[8] Pyramids of Ferrein.

1[9] Outer divisions of pyramids of Malpighi.

2[9] Divided by cortex.

8[4] Minute or microscopic structure.

1[5] Kidney a compound tubular gland.

1[6] Uriniferous tubules making it up.

1[7] Lined by epithelium.

2[7] Opening of on a papilla.

3[7] Twenty (about) open on papilla.

4[7] Diameter at papilla $\frac{1}{250}$ inch.

1[8] Diameter at smallest point $\frac{1}{600}$ inch.

5[7] Beginning in cortex.

1[8] Parts in order until ending.

1[9] Malpighian capsule or globular dilatation as beginning.

2[9] Descending limb of loop of Henle.

3[9] Loop of Henle.

4[9] Ascending limb of loop of Henle, into cortex.

5[9] Convoluted junctional tubule in cortex.

6[9] Collecting tubule in pyramid.

7[9] Excretory tubule formed by collecting tubules.

2[8] Passes through cortex and pyramid twice before excretion.

1[9] Gives a good chance of secretion of proper material.

2[5] Blood vessels.

1[6] Glomerulus, knot of capillaries connecting arteries and veins.

1[7] No glomeruli in kidney medulla.

2[6] Source of urine from blood.

3[6] Bright's disease caused because of pressure in and largeness of afferent vessels compared to efferent.

9[4] Secretion of urine.

1[5] Average quantity 40 to 60 fluid ounces daily.

1[6] Greater in winter, work, and other conditions.

2[5] Acid in reaction.

3[5] Specific Gravity 1022.

1⁶ More if quantity secreted be small.
4⁵ Color, clear amber-colored.
5⁵ Normal urine 4% or 40 out of 1000 solids.
1⁶ Principally urea, uric acid, salts, etc.
6⁵ 14% gas, 13% being carbon dioxide, 1% nitrogen, and slight trace of oxygen.
7⁵ Type of excrementitious matter.
8⁵ Produced in tissue.
10⁴ Mechanism of renal secretion.
1⁵ Two parts.
1⁶ Glomeruli, place of filtration from blood.
2⁶ An active secretory aparatus.
2⁵ Dialysis.
11⁴ Nervous control in blood supply and secretion.
2³ Ureters.
1⁴ Length, 11 to 13.5 inches.
2⁴ Opens into bladder dorsal aspect towards bottom and obliquely.
1⁵ Valve formed because of internal pressure.
3⁴ Diameter.
4⁴ Coats, three.
1⁵ External or fibrous.
2⁵ Middle or muscular.
3⁵ Internal or mucous.
3³ Urinary bladder.
1⁴ Coats.
1⁵ External, a reflection of peritoneum.
2⁵ Middle or muscular, three coats.
1⁶ Sphincter vesicae at mouth of bladder.
3⁵ Internal or mucous.
2⁴ Corpus trigonum, a triangular body near mouth of bladder composed of fibrous tissue.
3⁴ Blood vessels to it reach mucous membrane.
4⁴ Located lower abdomen.
5⁴ Hay stack shaped.
4³ Urethra, the final exit tube.

(*Martin*).

1 Secretion of urine in 24 hours.	1500 grams	23250 grains	In 10000 parts
1^1 Water	1428.00	22134.00	952.00
2^1 Solids	72.00	1116.00	48.00
1^2 Urea ($C\,N^2\,H^4\,O$)	33.00	511.50	22.00
2^2 Uric acid ($C^5H^4N^4O^3$)	0.50	7.75	0.33
3^2 Hipparic acid.	0.40	6.20	0.27
4^2 Kreatinin	1.00	15.50	10.33
5^2 Pigments and fats.	10.00	155.00	6.66
6^2 Sulphuric acid	2.00	31 00	1.33
7^2 Phosphoric acid	3.00	46.50	2.00
8^2 Chlorine	7.00	108.50	4.70
9^2 Ammonia	0.75	12.00	0.50
10^2 Potassium	2.50	38.75	1 70
11^2 Sodium	11.00	170.50	7 33
12^2 Calcium	0.25	3.80	0.16
13^2 Magnesium	0.20	3.00	0.13
TOTAL	71.60	1110.00	47.44

2^1 The skin.

1^2 Define.

2^2 Extent of skin about 12 to 16 square feet.

1^3 Varies with individual.

3² Thickness of skin.
1³ Varies according to pressure and individual.
4² Layers.
1³ Epidermis, cuticle, or scarfskin.
1⁴ Parts of.
1⁵ Horny layer on outside.
1⁶ Many hard polygonal flattened cells.
1⁷ Cells $\frac{1}{3000}$ to $\frac{1}{750}$ inch in diameter.
2⁷ Deepest cells more roundish.
2⁶ Thickness varies much.
3⁶ Dead outer scales of, peel off in shampooing, Turkish bath, etc.
2⁵ Malpighian layer or *retemucosum*.
1⁶ Elongated columnar and roundish cells.
1⁷ Deeper layer of cells possess nuclei.
2⁷ Length $\frac{1}{1000}$ to $\frac{1}{2000}$ inch in diameter.
3⁷ Width $\frac{1}{4000}$ to $\frac{1}{2000}$ inch in diameter.
2⁶ Thickness $\frac{1}{150}$ to $\frac{1}{75}$ inch.
3⁶ Pigment in deepest part.
1⁷ Freckles caused by pigment collecting in points.
1⁸ Mythical cures.
2⁷ Color of negro, etc.
1⁸ Albino.
2⁴ Great purpose of, a protection to the delicate structure of skin.
3⁴ Thickness, varies.
1⁵ Thinnest on face, eyelids, and auditory passages, $\frac{1}{750}$ to $\frac{1}{600}$ inch in diameter.
2⁵ $\frac{1}{8}$ to $\frac{1}{4}$ inch thick on palm.
3⁵ $\frac{1}{10}$ to $\frac{1}{5}$ inch thick on sole.
4⁴ Absence of blood vessels and lymph.
5⁴ Fine nerve fibers run into it. (*Martin*).
6⁴ Appendages of it.
1⁵ Hairs.
1⁶ Parts.
1⁷ Root.
1⁸ Located in hair follicle.

1⁹ Epidermic lining pulled up with root if plucked.

2⁹ Hair will grow if dermic papilla remain intact.

3⁹ Sebaceous glands at root for oiling hair.

2⁷ Stem.

3⁷ Point in uncut hair.

2⁶ Layers.

1⁷ Cuticle.

2⁷ Cortex.

1⁸ Pigment granules in its layers.

3⁷ Medulla.

3⁶ Light haired persons have finer hair generally than the dark.

4⁶ Uncut short hair generally heavier than long hair.

5⁶ Men generally have finer hair than women. (*Flint*).

6⁶ White hair caused by openings into hair reflecting light of different incidence.

7⁶ Muscles at root of hair. Hair standing on end.

8⁶ Found more or less over the Body as in all mammals

2⁵ Nails.

1⁶ Parts of.

1⁷ Root.

2⁷ Body.

3⁷ Free edge.

2⁶ Matrix or bed. the corium on which the body of nail is located.

1⁷ Lunula at base. Its thinness causes it.

2⁷ New nail is formed if nail is "cast" because of injury, providing matrix is not destroyed.

3⁶ Growth beneath and at root, most rapid longitudinally.

4⁶ Layers.

1⁷ Malpighian or deep.

2⁸ Horny.

1⁸ Part that forms free edge.

3⁵ Teeth so considered by some.

2⁴ Dermis, corium, cutis vera, cutis, or true skin.

1⁴ Parts of.
1⁵ Inner. Loose areolar tissue with fat in muscles.
2⁵ Outer papillary.
2⁴ Composition.
1⁵ Yellow and white fibrous tissue.
2⁵ Muscular tissue accompanying hair.
3⁵ Subcutaneous areolar tissue beneath.
3⁴ Appearance.
1⁵ Papillae.
2⁵ Furrows. wrinkles. Papillae in rows.
4⁴ Imbedded parts.
1⁵ Blood vessels.
2⁵ Lymphatics.
3⁵ Nerves.
4⁵ Hair follicles with epidermis dipping down.
5⁴ Glands.
1⁶ Sebaceous glands or oil glands.
1⁷ More numerous in connection with hair.
1⁸ Shriveled palm of washer-woman. No oil glands.
2⁷ Belong to the racemose type.
3⁷ Usually two accompanying hair follicle. May be one or more.
4⁷ Cells lining saccule breaking up and oil freed. New cells produced.
5⁷ 50% of fats (olein and palmatin).
2⁶ Sudoriparous or sweat glands; sudoriferous.
1⁷ Perspiration.
1⁸ Kinds.
1⁹ Sensible.
2⁹ Insensible.
2⁸ Things passed off.
1⁹ 990 water to 10 solids in 1000.
1¹⁰ Principal solids.
1¹¹ Urea.
2¹¹ Uric acid.
3¹¹ Sodium chloride.
4¹¹ Other salts and wastes.

2[9] Excretions about the same as of kidneys but in different proportions.

3[8] Under nervous control.

1[9] In fright, in fevers, etc.

2[7] Stimulating sciatic nerve of cat will cause balls of feet to sweat.

4[8] Ducts of, open on top of cuticle as do those of sebaceous.

2[7] Belong to the tubular type.

6[5] Touch papillae.

5 Functions of the skin.

1[3] General protection.

2[3] Heat regulation.

1[4] 78% of heat of Body passed through it.

3[3] Seat of sense of touch.

4[3] Secretion.

5[3] Excretion, perspiration, etc.

6[3] Gives beauty to Body.

6[2] Hygiene of skin.

1[3] Physiological use of clothing.

1[4] Protection against cold.

1[5] Fabrics best adapted.

1[6] For winter, woolen. Two light garments warmer than one. Value of nap.

2[6] Light colored clothing better than dark.

2[5] Necessity of keeping warm despite the dictates of fashion.

2[4] Protection against heat.

1[5] Fabrics best adapted.

1[6] Cotton light enough. Linen permits too much of a variation.

3[4] Protection against injury, etc.

4[4] Under clothing necessary the whole year.

2[3] Necessity of bathing.

1[4] To cleanse the skin.

2[4] To prepare for proper work of scavenger, so its function can be fulfilled.

3⁴ Time of taking a bath.
1⁵ When blood is not needed at another part.
4⁴ Method of taking bath.
1⁵ Depends on health.
2⁵ Depends on age.
3⁵ Depends on climatic conditions.
5⁴ Turkish and Russian baths.
6⁴ Value of reaction.
7⁴ Effect of soap.
7³ Diseases of skin.
1⁵ Erysipelas.
1⁴ Generally stopped by a solution of iodine.
2⁵ Corns. Thickened cuticle produced by friction.
1⁴ Most frequent on feet but found on shoemaker's knee.
3⁵ Ingrowing nails.
1⁴ Value of scraping nail and wearing large enough shoes or boots.
4⁵ Warts, overgrown papillae.
1⁴ Value of nitric acid in removing them.
5⁵ Chilblain.
6⁵ Wens, boils, etc.
8³ Effect of varnishing skin.

NOTES —

1. Albino —It., whitish, from Lat., *albus*, white.
2. Cortex —Lat., the bark.
3. Cortical —Lat., *cortex*, the bark.
4. Cutis —Lat., the true skin.
5. Cuticle —Lat., *cutis*.
6. Cutis vera —Lat., *cutis*, and *vera*, true.
7. Dermis —Gr., *derma*, gen. of *dermatos*, the skin.
8. Epidermis —Gr., *epi* upon, and *derma*, the skin.
9. Glomerulus —Lat., *glomus*, a ball.
10. Hilus —Lat., *hilum*, the eye of a bean.
11. Kidney —A. S., *quidh*, belly, and Eng., *nigh*.
12. Lunula—Lat., diminutive of *luna*, the moon.
13. Matrix —Lat., *mater*, mother.
14. Sebaceous —Lat., *sebum*, tallow.
15. Sudoriparous—Lat., *sudor*, sweat, and *parare*, to furnish.
16. Sudoriferous —Lat., *sudor*, and *ferre*, to bear.
17. Uniferous —Lat., *urina*, urine, and *ferre*, to bear
18. Urine—Lat., *urina*, urine.
19. Uric —Gr., *ouron*, urine.
20. Ureter —Gr., *ourein*, to make water.
21. Urethra—Gr., *ourein*, to make water.

1. Nervous System.

1¹ General functions of it.

1² Coordination carried on through it.

1³ Of various organs and parts.

2³ Of cells.

2² Master builder in the construction of any part of the Body.

1³ May be impelled by the will.

1⁴ Faith cure.

3² As a protector to the Body.

1³ By receiving sensations from without.

2³ By transmitting motor impulses and volitions outward.

4² Harmonizes and equalizes all parts of system.

1³ No part of work of Body can be performed excepting through it.

5² Sensations known.

1³ Common.

2³ Special.

6² Regulation of motion.

7² Regulation of intelligence, will, and emotion.

8² Gives a basis for faculty of language.

9² Regulation of nutrition, secretion, excretion, etc.

2¹ Chemical composition of nervous substance.

1² The nerve substance proper.

1³ Protagon—($C^{116}H^{211}O^{2}N^{4}P$).

2³ Neurine.

3³ Cerebral fatty principles: cerebrine or lecithin.

4³ Copora amylacea.

1⁴ Found in corpora striata and medulla.

3¹ General divisions of nervous system.

1² As to arrangement of tissue and as to nervous force.

1³ Nerve centers.

1⁴ Outer covering.

2⁴ Intercellular substance.

3⁴ Peculiar corpuscles, myelocytes.

4⁴ Connective tissue elements.

5⁴ Blood vessels and lymphatics.

6⁴ Gray or vesicular and white matter.

4⁷ Nerve cells of, capable of generating nerve-force.

2⁴ Nerves.

1⁴ Nerve fiber.

1⁵ Act only as conductors and incapable of generating nerve-force.

2⁵ "Nervous impulses" sent over them.

3⁵ Connect irritable tissues to the automatic, coordinating, and sensory tissues.

4⁵ Kinds as to color.

1⁶ White.

1⁷ Principally connected with cerebro-spinal nerves.

2⁶ Gray.

2⁷ Principally connected to sympathetic trunks.

2⁴ Covering, composition, etc.

2³ As to color of substance.

1³ Gray or vesicular.

1⁴ Inside of spinal cord but principally on outside of brain.

2³ White, makes up the rest.

3³ As to arrangement into systems.

1³ Cerebro-spinal.

1⁴ Concerned in functions of relation or animal life.

2⁴ Divisions.

1⁵ Spinal cord: (*spinal marrow*).

1⁶ Location—in neural canal.

2⁶ Length, 17 in.; varies.

3⁶ Average diameter, ¾ inch.

1⁷ Enlargements or expansions.

1⁸ Due to increase of white matter.

2⁸ Kinds.

1⁹ Cervical—third cervical to first dorsal vertebrae.

2⁹ Lumbar—opposite last dorsal vertebra.

4⁶ Weight—1½ oz., (42.5 grams).

5⁶ Connection to brain, through *foramen magnum*.

6⁶ Shape of cross section.

1⁷ Broader laterally, nearly circular.

7[6] Functions of cord.
1[7] Transmits afferent or efferent "*nervous impulses.*"
2[7] Serves the purpose of a nerve center.
1[8] Reflex action of lower part of Body.
1[9] Tickling of feet when spinal cord is cut off.
8[6] *Filum terminale*, end of spinal cord.
9[6] Structure.
1[7] Covering of spinal cord, meninges.
1[8] Outer—dura mater.
2[8] Middle—two layers of arachnoid membrane.
1[9] Cerebro-spinal or cephalo-rachidian fluid between.
2[9] Cerebro-spinal fluid also between *arachnoid* and *pia mater*.
3[8] Inner—*pia mater;* sometimes called neurilemma.
1[9] Lines anterior fissure.
2[9] Fills posterior fissure.
3[9] Processes thrown into cord substance.
2[7] Appearance of cross section. *
1[8] White matter without.
1[9] White columns.
1[10] Anterior right and left white columns.
2[10] Posterior right and left white columns.
1[11] Disease of locomotor ataxia affects this part.
3[10] Lateral right and left white columns.
2[8] Gray interior.
1[9] Crescents—two, right and left.
1[10] Anterior cornua, right and left, (ventral).
1[11] Thicker and larger than posterior, also farther from surface of cord.
2[11] Anterior nerve root originates above it.
2[10] Posterior cornua, right and left, (dorsal).
1[11] Close to surface.
2[11] Posterior spinal nerve root originates from it.
3[10] Body of crescent.
2[9] Gray commissures.
1[10] Anterior.

2[10] Posterior.

3[10] Canalis centralis between commissures.

1[11] Afterward expands in brain as ventricles.

3[7] Fissures or sulci.

1[8] Anterior, wider and shallower, (ventral).

2[8] Posterior, narrower and deeper, (dorsal).

4[7] Anterior white commissure.

5[7] Neuroglia, the finely granular connective tissue of brain and spinal cord.

6[7] Decussation of nerve fibers carried forward nearly through entire course: completed in Medulla.

10[6] Paraplegia.

11[6] Spinal nerves.

1[7] Roots.

1[8] Anterior.

1[9] Possesses power of sending out motor impulses.

2[8] Posterior.

1[9] Ganglion on root before junction with anterior.

2[9] Possesses power of transmitting sensory impulses.

2[7] Nerves divide into posterior primary and anterior primary branches.

1[8] Posterior to skin and muscles of back.

2[8] Anterior to neck, trunk, and limbs.

3[7] Pairs—31.

1[8] Eight cervical.

1[9] Last cervical between cervical and dorsal.

2[9] First cervical between occipital and atlas.

2[8] Twelve dorsal.

3[8] Five lumbar.

4[8] Five sacral.

5[8] One coccygeal.

4[7] Plexuses.

1[8] Cervical.

1[9] Formed by anterior primary branches of first four cervical nerves.

2[9] Branches to neck, outer ear, and back of scalp.

*See Martin's physiology for cross section.

3⁹ Phrenic nerve formed by 4th and 5th cervical.
2⁸ Brachial.
1⁹ Formed by anterior primary branches of, from 5th cervical to 1st dorsal.
2⁹ Branches to upper limbs and thorax wall.
3⁹ From cervical enlargement.
3⁸ Lumbar.
1⁹ Formed by anterior primary branches of four anterior lumbar nerve pairs.
2⁹ Branches to trunk, buttocks, thigh, and leg.
4⁸ Sacral.
1⁹ Formed by anterior primary branches of fifth lumbar and first four sacral pairs.
2⁹ Principal nerve formed, sciatic.
12⁶ Paraplegia, a paralysis of lower half of both sides of Body—disease of spinal cord.
13⁶ *Cauda equina*, "horse's tail:" bunch of nerve filaments in neural canal of lumbar and sacral regions.
14⁶ Education of the cord.
2⁵ Brain or encephalon.
1⁶ Shape, like an ellipse on top.
2⁶ Size—varies.
3⁶ Weight 50 ounces in male, 44.5 ounces in female.
4⁶ Location in cranium, bony case.
5⁶ Covering from without in, meninges.
1⁷ Dura mater.
1⁸ Serves as periosteum to cranial bones within.
2⁸ Tentorium cerebelli, process of it, between cerebellum and cerebrum.
3⁸ Falx cerebri, process of it in deep median longitudinal fissure.
4⁸ Falx cerebelli, between lateral halves of cerebellum.
2⁷ Arachnoid membrane.
1⁸ Two layers.
1⁹ Parietal.
2⁹ Visceral.
3⁷ Pia mater.

1[8] Forms velum interpositum and choroid plexus in ventricles of brain.

2[8] Follows closely the brain substance, generally dipping into sulci but may pass over.

4[7] Cerebro-spinal meningitis, a disease of coverings.

6[6] Location of cerebro-spinal or cephalo-rachidian fluid.

1[7] In space between arachnoid membrane—arachnoid space.

2[7] In space between arachnoid membrane and pia mater.

3[7] In ventricles and canalis centralis.

1[8] Connection of subarachnoid space with fourth ventricle.

4[7] Sulci filled if pia mater does not dip down.

7[6] Brain increases from 11.65 oz. to 50 oz. in male and 10 to 44.5 oz. in female.

1[7] Rapid increase till seven years.

2[7] Slower increase till sixteen or twenty years.

3[7] Slower still till thirty-one or forty years.

4[7] Diminution in weight after forty.

8[6] Brain fissures according to Dalton. *

1[7] Deep median fissure.

2[7] Lateral fissure.

1[8] Fissure of Sylvius, lower front.

2[8] Fissure of Rolando, upper front.

3[8] Parietal fissure, parietal region.

9[6] Color of brain matter or kinds.

1[7] Vesicular or gray matter.

1[8] Found on outside of brain principally but scattered all through.

2[8] In spinal cord, found within.

2[7] White.

1[8] Within brain, outside of spinal cord.

2[8] *Arbor vitae* formed by white matter radiating through gray matter of cerebellum.

*Refer to Flint for figure.

10^{6} Divisions of brain.

1^{7} Fore brain.

1^{8} Cerebrum.

1^{9} Location in upper and front cranial cavity.

2^{9} Hemispheres.

1^{10} Basal ganglia found beneath and imbedded in them.

1^{11} *Corpora striata*, gray mass.

1^{12} One on each side.

2^{11} Optic thalami, two on each side.

1^{12} Gray masses.

3^{11} Olfactory lobes.

1^{12} Large in fishes.

2^{12} Seat of sense of smell.

2^{10} Connection between them.

1^{11} Corpus callosum.

2^{11} Commissures.

1^{12} Anterior.

2^{12} Median.

3^{12} Posterior.

3^{10} Hemiplegia.

3^{9} Functions of cerebrum.

1^{10} Intelligence and intellect located in cerebrum. (intellectual faculties. many propensities and sentiments).

1^{11} Faculty of language has its center in anterior cerebral lobes.

1^{12} Aphasia and agraphia distinguished from aphonia.

2^{10} Origin even of instinctive acts.

3^{10} Effect of removal of cerebrum.

1^{11} Sensation still intact.

2^{11} Entire loss of memory and power of connecting ideas.

3^{11} Animal still sees, hears, and (if olfactory lobes remain behind) smells but forms no idea of it.

4[11] If animal be set in motion, movement continues until animal is stopped or exhausted.

4[9] High development in intellectual races.

5[9] Idiots have comparatively small cerebrum.

1[10] A few exceptions have been noted.

6[9] Average weight—44 ounces, (a little over $\frac{1}{40}$ of brain).

7[9] Ventricles of cerebrum, (expansion and continuation of canalis centralis).

1[10] Third ventricle.

1[11] Foramens of Monro leading into lateral.

2[11] Aqueduct of Sylvius downward to fourth ventricle, (*iter a tertio ad quartum ventriculum*).

1[12] Pineal gland located dorsally above aqueduct of Sylvius.

1[13] Seat of soul. (?) (*Descartes.*)

2[13] No nervous tissue.

3[11] Location, floor of cerebrum, dorsal aspect, median line, right above medulla oblongata.

1[12] Below septum lucidum and back part of corpus callosum.

4[11] Pituitary body or hypophysis cerebri below it.

5[11] Corpora albicantia below it.

2[10] Lateral ventricles.

1[11] Lined by septum lucida on inner wall.

2[11] Foramens of Monro lead to it.

3[11] Apoplexy often caused by bleeding into lateral ventricles.

1[12] Cure, keep patient quiet until medical aid.

4[11] First and second.

3[10] Fifth ventricle.

1[11] No connection with other ventricles or with canalis centralis.

2[11] Location.

1[12] Between septum lucida on sides and part of corpus callosum above.

4[10] Lined by epithelium, ciliated in early life: a sort of continuation of pia mater.

8[9] Direction of fibers.
1[10] All start from medulla oblongata.
2[10] Go all directions to surface.
9[9] Cerebral convolutions or gyri.
1[10] Very many and very highly developed.
2[10] Deepest fissures or sulci dividing them. *
1[11] Deep median or longitudinal fissure.
1[12] Separates hemispheres.
2[11] Fissures of Sylvius.
1[12] Anteriorly below.
3[11] Fissures of Rolando.
1[12] Superior middle of each hemisphere.
4[11] Parietal fissures.
1[11] In parietal region.
10[9] Development in different races and individuals. (*See Flint*).
2[8] General properties of fore brain.
1[9] Neither excitable nor sensible of injury to itself.
1[10] Excitability has been attributed to some parts.
1[11] Effect seen in tetanic contraction.
2[7] Mid brain.
1[8] Eminences. *
1[9] Copora or tubercula quadrigemina. 4.
1[10] Nates, anterior pair.
2[10] Testes, posterior pair.
3[10] Location, on dorsal aspect.
4[10] Birds only possess two.
2[8] Pillars. *
1[9] Crura cerebri, two.
1[10] Location, ventral aspect.
3[8] Function, to connect fore brain to hind brain.
4[8] Not very large.
5[8] Aqueduct of Sylvius in it.
3[7] Hind brain.
1[8] Divisions.

*If you secure the brain of a beef, and make a careful examination and dissection, you can see these parts with many others. I would urge this kind of work.

1[9] Cerebellum.
1[10] Weight, 5.2 ounces in male and 4.7 ounces in female.
2[10] Separated from cerebrum by tentorium cerebelli.
3[10] Lobes.
1[11] Right hemisphere.
2[11] Left hemisphere.
3[11] Median lobe.
4[10] Arbor vitae.
1[11] Leaf composed of white matter.
1[12] Gray matter dipping into its notches.
5[10] General properties of cerebellum.
1[11] Lesion or irritation of it produces neither pain nor convulsion.
6[10] Functions of cerebellum.
1[11] Presides over co-ordination and equilibration voluntary movements.
2[11] Removal of half of cerebellum may cause only temporary loss of its functions.
3[11] Functions carried on through posterior white columns of spinal cord.
1[12] Locomotor ataxia.
7[10] Peduncles.
2[9] Medulla Oblongata.
1[10] Above spinal cord, broad end up.
1[11] In basilar groove of occipital bone.
2[10] Continuation of spinal cord.
3[10] Possesses anterior, posterior, and median fissures.
4[10] Anterior pyramids parallel with anterior fissure, joining with cord.
1[11] Decussation of pyramids or fibers.
1[12] Hemiplegia.
5[10] Olivary body external to anterior pyramid.
1[11] Restiform body behind it.
1[12] Fourth ventricle found between thetwo restiform bodies.

1^{13} Canalis centralis below and aqueduct of Sylvius above.

2^{13} Connection with sub-arachnoid space.

6^{10} Posterior pyramids.

7^{10} Corpora dentata.

8^{10} Functions of.

1^{11} Conductor of sensory impressions and motor stimuli.

2^{11} A prominent point in reflex action.

1^{12} Yawning, coughing, sneezing, etc.

2^{12} Power over co-ordination of muscles of expression and in vomiting.

3^{12} Controls influence of heart probably in diastole.

9^{10} Vital point or knot, ganglion of life, or respiratory center found in it.

1^{11} Respiration stops upon its destruction.

2^{11} Artificial respiration can, however, sustain life.

10^{10} Length $1\frac{1}{4}$ inches.

11^{10} Thickness, $\frac{3}{4}$ inch.

12^{10} Width, $\frac{1}{2}$ inch.

13^{10} Functions of medulla oblongata.

1^{11} The respiratory center.

2^{11} The cardio-inhibitory center.

3^{11} The vaso-motor center.

4^{11} The center for the dilator muscles of pupils of eye.

5^{11} The center for the muscles of chewing and swallowing.

6^{11} The convulsive center.

7^{11} The center exciting salivary glands reflexly.

8^{11} The diabetic center.

9^{11} The center of complex bodily movements.

10^{11} As a whole the center of the nutritive processes.

11^{11} As a transmitter.

3[8] Pons Varolii, meso-cephalon, tuber annulare.
1[10] White externally.
2[10] Connects two parts of cerebellum.
3[10] Connects medulla below with mid brain on top.
11[6] Sinuses of brain.
12[6] Basal ganglia.
1[7] Corpora striata.
2[7] Optic thalami.
3[7] Olfactory lobes.
4[7] Corpora quadrigemina.
5[7] Medulla oblongata.
6[7] Pineal gland.
7[7] Pituitary body.
13[6] Convolutions or gyri.
1[7] Size of convolutions a mark of intelligence.
2[7] Largest in cerebrum.
14[6] Ventricles of brain.
1[7] First, second, third, fourth, and fifth.
2[7] All except fourth found in fore brain.
15[6] Cranial nerves.
1[7] According to origin. *
1[8] From fore brain.
1[9] First pair, olfactory nerves.
1[10] Origin, olfactory lobes.
2[10] Distal end—nose.
2[8] From mid brain and fore brain.
1[9] Second pair, *optic*.
1[10] Origin, corpora quadrigemina.
1[11] Branches from optic thalami and others.
2[10] Distal end, eye.
3[10] Special nerves of sight.
4[10] Optic tracts to base of brain.
5[10] Optic commissures.
1[11] An optic nerve proceeds from each.

*The classification used is that of the continental or that by Somering. The other is the British whose author is Willis. He only gives nine pairs. The facial and auditory together composing 7th pair, the pneumogastric glosso-pharyngeals, and spinal accessory forming eight pair.

3^{8} From hind brain.

1^{9} Third pair, *motores oculi*.

1^{10} Controls dilatation of pupil.

2^{10} Section of, causes ptosis or blepharoptosis.

3^{10} Origin, pons Varolii.

4^{10} Distal end, ball and muscles of eye.

2^{9} Fourth pair, pathetici or trochleari.

1^{10} Origin, fourth ventricle, ventral side.

2^{10} Distal end, one muscle of eyeball.

3^{9} Fifth pair, trigeminales or trifacial.

1^{10} Two roots.

1^{11} Gasserian ganglion on larger root.

2^{10} Origin, near Gasserian ganglion.

3^{10} Divisions.

1^{11} Ophthalmic, forehead and upper eyelid.

2^{11} Superior maxillary nerve.

1^{12} To temple, cheek, upper teeth, pharynx, roof of mouth, etc.

3^{11} Inferior maxillary nerve.

1^{12} Side of head, external ear, tongue, lower teeth, salivary glands, and muscles of lower jaw.

4^{10} Nerve affected in toothache.

5^{10} The only one of cranial nerves, unmixed.

4^{9} Sixth pair, abducentes.

1^{10} Origin, posterior margin of pons Varolii.

2^{10} Distal end, external rectus muscle of eye.

3^{10} Third, fourth, and sixth sometimes called motores oculi.

5^{9} Seventh pair, facial or portio dura, (nerve of expression).

1^{10} Origin, posterior margin of pons Varolii.

2^{10} Distal, muscles of face and scalp.

3^{10} Together with auditory forming seventh pair in English classification.

6^{9} Eighth pair, auditory nerves.

1^{10} Origin, pons Varolii.

2^{10} Distal end, internal ear.

3^{10} Special nerve of hearing.

7^{9} Ninth pair, glosso-pharyngeals.

1^{10} Origin, near auditories.

2^{10} Distal end, pharynx, posterior part of tongue and middle ear.

8^{9} Tenth pair, pneumogastric or par vagum nerve.

1^{10} Origin, sides of medulla oblongata.

2^{10} Distal end of distribution of branches.

1^{11} Auricular.

1^{12} Given off from ganglion.

2^{12} Receives filaments from facial or glosso-pharyngeals.

2^{11} Pharyngeal.

3^{11} Superior laryngeal.

1' Irritation of inferior constrictor muscle of larynx.

4^{11} Inferior or recurrent laryngeal.

5^{11} Cardiac, cervical, and thoracic.

6^{11} Pulmonary, anterior and posterior.

7^{11} Oesophageal.

8^{11} Abdominal.

1^{12} Stomach, and right division to intestines.

3^{10} Connection with important organs of respiration, digestion, and circulation.

4^{10} Longest course of any cranial nerve.

5^{10} Kick in stomach, drinking very cold water, etc., sometimes cause heart to stop. Why?

9^{9} Eleventh pair, spinal accessory.

1^{10} Origin, brain and spinal cord.

2^{10} Distal end, muscles of shoulder.

1^{11} One branch joins pneumogastric.

10^{9} Twelfth pair, hypoglossi.

1^{10} Origin, sides of medulla oblongata.

2^{10} Distal end, muscles of tongue and hyoid bone.

4^{8} Superficial origin is given, deep origin not well determined.

2^{7} According to function or physiological.
1^{8} Nerves of special sense.
1^{9} Olfactory.
2^{9} Optic.
3^{9} Auditory.
4^{9} Gustatory part of glosso-pharyngeal and one branch of facial for taste.
2^{8} Nerves of motion.
1^{9} Nerves of eyeball.
1^{10} Motor oculi communis.
2^{10} Patheticus.
3^{10} Motor oculi externus.
2^{9} Nerves of mastication.
3^{9} Facial.
4^{9} Spinal accessory.
5^{9} Ninth pair, sublingual or glosso-pharyngeals.
3^{8} Nerves of general sensibility.
1^{9} Trifacial.
2^{9} Part of glosso-pharyngeal.
3^{9} Pneumogastric.
3^{7} Ganglia on cranial nerves.
2^{3} Sympathetic system.
1^{4} Ganglia—49.
1^{5} Definition.
2^{5} Pairs.
1^{6} Three cervical.
1^{7} Superior, middle, and inferior.
2^{7} Opposite third, fifth, and seventh cervical vertebrae.
2^{6} Twelve dorsal or thoracic.
1^{7} Great splanchnic nerve formed by seventh, eighth, and ninth.
1^{8} Controls diaphragm and kidneys.
3^{6} Four lumbar.
4^{6} Five sacral.
3^{5} One ganglion in front of coccyx, the ganglion impar.
1^{6} A medium of connection between the two rows.
4^{5} Ganglia connected by *sympathetic cord* and rows below.

5[5] Sporadic ganglia.
1[6] Found in blood vessels and secretory tissues.
2[6] Possibly belong to sympathetic system.
3[6] Connected to cerebro-spinal and sympathetic systems.
4[6] Quite a number located in heart.
2[4] Sympathetic nerves.
1[5] Found in.
1[6] Blood vessels as arteries—vaso-motor nerves.
1[7] Regulation of heat in different parts.
2[6] Abdominal and thoracic viscera.
3[6] More or less through other parts of Body.
2[5] Function.
1[6] Regulates nutrition, calorification, and secretion.
2[6] Has an important use to perform in reflex action.
3[5] Plexuses.
1[6] Most important.
1[7] Cardiac plexus, dorsal side of heart.
2[7] Solar plexus in abdominal cavity.
1[8] Nerves go to stomach, liver, kidneys, and intestines.
4[5] Grayer in color than cerebro-spinal.
5[5] Connection to cerebro-spinal nerve.
4[1] Structure of nervous system.
1[2] Of nerve centers.
1[3] White and gray nerve fibers.
2[3] Nerve cells.
3[3] Connective tissue.
4[3] Blood vessels.
5[3] Centers do not merely transmit and reflect but co-ordinate as well.
2[2] Of nerves.
1[3] White and gray matter, gray within generally.
2[3] Nerve cells.
3[3] Connective tissue.
4[3] Blood vessels.
5[3] Histology.

1⁴ Covering, perineurium.
1⁵ Divides nerve into funiculi.
1⁶ Covering of funiculus—neurilemma.
2⁶ Nerve fibers within.
1⁷ Primitive sheath covering fiber.
1⁸ Medullary sheath, a fatty substance within.
1⁹ Axis cylinder within.
1¹⁰ Essential part of nerve.
2⁹ Nuclei at intervals of $\frac{1}{25}$ inch.
3⁹ Nodes half way between nuclei.
2⁷ Diameter about $\frac{1}{2000}$ inch.
3⁷ Length, from center to end.
1⁸ In sciatic nerve about four feet.
2⁸ May be any length.
6³ Simply convey impulses.
3² Histology of nerve cell.
1³ Cell body or cell protoplasm.
2³ Nucleus.
3³ Nucleolus.
4³ Diameter of nerve cell $\frac{1}{250}$ inch in anterior cornua of cord. —
5¹ Interconnunication of nerve centers.
1² Comparison of nervous system to Western Union Telegraph system.
1³ Brain and spinal cord, head offices in New York.
2³ Sympathetic ganglia second important offices in other large cities.
3³ Sporadic ganglia, minor offices in country stations.
4³ Nerves, telegraph wires connecting all.
6¹ Nervous impulse.
1² Nature of.
1³ A molecular change of a wavelike character, 18 millimeters in length.
2³ No electrical impulse.
1⁴ An electric shock may excite a nerve.
2² Rate of nervous impulse 33 meters or 108.2 ft. per second.

1³ ⅓ the rate of transmission of sound in air at 0° C.

7¹ Properties of nervous system.

1² The feeling of pain does not reside in part affected.

1³ Proof found in divided nerves.

2² Part affecting originates some change in nerve and finally nerve center, causing a feeling.

3² Nerve excited does not immediately call forth muscular contraction.

4² Nervous impulses are reflected or sent back to act upon muscles.

1³ Nerves divided make it impossible for will to act.

2³ Sensory and motor nerves shown by loss of sensation or motion while others remain a force.

5² Volition and consciousness are dependent on states of brain.

6² Spinal cord has, besides power of reflex action, power of conduction.

8¹ Classification of nerve centers.

1² Automatic.

1³ Examples. (1) cardio-inhibitory ganglia: (2) vital knot of medulla.

2² Reflex.

1³ Primary actions of.

1⁴ Sneezing, coughing, winking.

2³ Secondary actions of.

1⁴ Walking, riding, or any other acts.

2⁴ Law.—*The mind tends to act again more readily in a manner or form which is similar to any in which it has acted before in any defined exertion of its energy.*

3⁴ The great educative actions of the soul.

4⁴ Habits are acquired reflex actions.

9¹ Classification of nerve fibers and nerves.

1² Peripheral.

1³ Afferent, centripetal.

1⁴ Sensory, (result sensation).

2⁴ Reflex.

3⁴ Excito-motor, (cause a stimulation of efferent nerves).

4⁴ Centro-inhibitory?
2³ Efferent, centrifugal.
1⁴ Motor.
2⁴ Vaso-motor.
3⁴ Secretory.
4⁴ Trophic?
1⁵ Disease, "shingles."
5⁴ Peripherally acting inhibitory nerves.
2² Intercentral.
1³ Exciting.
2³ Inhibitory.
10¹ Nerve stimuli.
1² General nerve stimuli.
1³ Electric.
1⁴ An electric shock powerfully excites nerve fibers.
2⁴ A gradual current or change does not affect nerve.
2³ Mechanical.
1⁴ Sudden will produce excitation, gradual will not.
3³ Thermal stimuli.
1⁴ Sudden will and slow will not.
4³ Chemical.
1⁴ Strong solution excites, but slow chemical change does not.
2⁴ Killing of nerve with strong sulphuric acid without stimulation.
2² Special nerve stimuli. (really none).
1³ On efferent fibers.
1⁴ A change in central organ of which we know nothing.
2³ On afferent fibers.
1⁴ Light, in eye.
2⁴ Sound, in ear.
3⁴ Heat, in skin.
4⁴ Chemical, when very feeble, (taste and smell).
5⁴ Mechanical, when very feeble.
1⁵ .03 grain pressure can be felt on back of hand or on forehead.
6⁴ Less degrees of general stimuli on special organs.

11[1] Specific nerve energies.
  1[2] Dependent on the part excited and not the excitant.
    1[3] Sun's rays in eye, sight; on hand, warmth.
    2[3] Stroke on hand, feeling; on eye, a flash of light.
12[1] Proof showing similarity of afferent and efferent fibers in their properties. (*Martin, H. B. 193-4-5*).
13[1] Hygiene of brain.
  1[2] Improved and strengthened by exercise.
  2[2] Injured by overwork or idleness.
  3[2] Special faculties may be developed and others remain fallow.
    1[3] May lose power of using the fallow ones at all.
    2[3] Lop sided being.
      1[4] Value of a good general education on a broad basis of science, literature, and mathematics.
14[1] Comparisons of nervous system of man with other animals.

NOTES.—

1. Arachnoid—Gr., *arachne*, spider's web, and *eidos*, form.
2. Arbor vitae—Lat., *arbor*, tree, and *vitae*, of life.
3. Aphasia—Gr., *a*, privative, and *phanai*, to speak.
4. Agraphia—Gr., *a*, privative, and *graphein*, to write.
5. Aphonia—Gr., *a*, privative, and *phone*, voice.
6. Abducentes—Lat., *ab*, from, and *ducere*, to lead.
7. Automatic—Gr., *autos*, self, and *mathein*, to learn.
8. Brachial—Lat., *brachium*, the arm.
9. Corpora amylacea—Lat., *corpus*, body, and *amylum*, starch.
10. Corpora striata—Lat., *corpus*, body, and *stria*, a thread like line.
11. Corpora quadrigemina—Lat., *corpus*, body, *quatuor*, four, and *gemini*, twins.
12. Corpus callosum—Lat., *corpus*, body, and *callosum*, hard skinned.
13. Cornua—Lat., plural of *cornu*, a horn.
14. Cervical—Lat., *cervix*, neck.
15. Cephalo-rachidian—*cephalic*, pertaining to the head, and *rachis*, the vertebral column.
16. Cerebellum—Lat., diminutive of *cerebrum*, the brain.
17. Dura-mater—Lat., *dura*, hard, and *mater*, mother; called *mater* because of false thought of its giving rise to every membrane of Body.
18. Dorsal—Lat., *dorsum*, the back.
19. Filum terminale—Lat., *filum*, a thread, and *terminale*, terminal.
20. Glosso pharyngeals—Gr., *glossa*, the tongue, and pharynx.
21. Hemiplegia—Gr., *hemi*, half, and *plege*, a stroke.
22. Hypoglossal—Gr., *ypo*, under, and *glossa*, the tongue.
23. Intercentral—Lat., *inter*, among, and *centrum*, the center.

24. Inhibitory—Lat., *in*. not, and *habere*, to hold.
25. Lumbar—Lat., *lumbus*, the loin.
26. Locomotor ataxia—Lat., *locus*, place, and *movere*, to move. Gr., *a*, priva tive, and *taktos*, arranged.
27. Myelocytes—Gr., *mylos*, marrow, and *kytos*, a cell.
28. Neurine—Gr., *neuron*, a nerve.
29. Neurilemma—Gr., *neuron*, a nerve, and *lemma*, a rind.
30. Neuroglia—Gr., *neuron*, ligament, and *glia*, glue.
31. Olfactory—Lat., *olere*, to smell, and *facere*, to make.
32. Ophthalmic—Gr., *ophthalmos*, pertaining to the eye.
33. Pia-mater—Lat., *pia*, tender, and *mater*, mother.
34. Paraplegia—Gr., *para*, beside, and *plessein*, to strike.
35. Pituitary—Lat., *pituita*, phlegm; ancients erroneously supposed it to be the cause of secreting phlegm.
36. Pineal—Lat., *pinea*, the cone of a pine.
37. Peduncle—Lat., *pedunculus*, diminutive of *pes*, *pedis*, a foot
38. Pons Varolii—Lat., *pons*, a bridge, and of Varolius.
39. Portio-dura—Lat., *pars*, *partis*, part, and *dura*, hard.
40. Pneumogastric—Gr., *pneumon*, a lung, and *gaster*, the stomach.
41. Periphery—Gr., *peri*, around, and *pherein*, to bear or carry.
42. Reflex—Lat., *re*, again, and *flectere*, to bend.
43. Sympathetic—Gr., *syn*, with and *pathos*, suffering.—
44. Sulcus—Lat., a furrow.
45. Septum lucidum—Lat., *septum*, a partition, and *lux*, *lucis*, light.
46. Sporadic—Gr., *sporein*, to scatter like seed.
47. Tentorium cerebelli—a tent of cerebellum.
48. Trigeminals—Lat., *tri*, three, and *geminus*, a twin.
49. Trophic—Gr., *trophos*, a feeder; pertaining to nutrition.
50. Ventricles—Lat., diminutive of *venter*, the belly.

1. The Senses or Sensations.

1¹ Really modification of one common primary sensibility as found in hydra.

2¹ Sensation not a condition of sense organ but a condition of brain.

1² Organs only an instrument to originate nervous impulses.

3¹ Distinction between a perception and a sensation.

1² Neurosis, the quality belonging to sensation.

2² Psychosis, the quality belonging to perception.

1³ May place feeling at end of hair.

2³ May place feeling at end of insensible object not a part of ourselves.

4¹ Sensory illusions.

1² Expressions.

1³ "I must believe my own eyes."

2³ "We can't always believe our senses."

2² Facts.

1³ Moon's appearing larger rising or setting than in zenith.

2³ Light gray paper on white sheet, gray: on bright green surface, purple: on bright red surface, blue-green.

5¹ Weber's or Fechner's "psycho-physical law." "*The sensation increases proportionately to the logarithm of the strength of the stimulus.*"

6¹ Classes.

1² Common or general.

1³ Very many and hard to distinguish exactly.

2³ Classes.

1⁴ Vital.

1⁵ Pain in all its forms.

1⁶ Pain a condition of ourselves.

2⁶ Located in part affected or its end organ.

1⁷ Amputated limb and feeling at end of original organ, if nerve of stump be irritated.

3⁶ Found in brain. (Test, eye with cut optic nerve).

2^5 Rest and fatigue.

3^5 Vigor and languor.

4^5 Health and sickness.

5^5 Temperature, etc.

2^4 Organic: (connected with nutritive, circulatory, respiratory, and other organs).

1^5 Hunger and thirst.

1^6 Regulates taking of food.

2^6 Indigestible substances may for a time allay hunger but hunger will not fully be duped.

3^6 Injections into blood will still them as well as to eat.

4^6 Mode of entry of food and water not special.

2^5 Nausea, satiety, etc.

2^2 Special.

1^3 Of greater intellectual value than common.

2^3 Number of 5, 6, 7, or 8, according to authority.

1^4 5 well fixed, and probably six or seven.

2^4 Cause of difference in sensation dependent on organs and not excitant.

1^5 Visual sensation produced by light, pressure, electricity, and cutting.

3^4 Seeing and hearing are the two most specialized sensations.

4^4 Essential structure of special sense organ.

1^5 Cells capable of being stimulated by a special form of energy that acts on that sense organ.

2^5 A nerve to conduct the impulses thus produced.

3^5 A nerve center to receive impulses and give rise to sensations.

3^3 Organs of: accessory organs of sensation.

1^4 Visual apparatus.

1^5 Essential parts.

1^6 Retina.

2^6 Optic nerve.

3^6 Visual center.

4^6 Light not essential. See 1^5 under 2^4 above.

2^5 The eye.

1[6] Accessory parts or appendages.
1[7] Eye socket.
1[8] Located in orbit.
1[9] Bones forming cavity.
1[10] Malar.
2[10] Lachrymal.
3[10] Ethmoid.
4[10] Superior maxillary.
5[10] Frontal.
6[10] Sphenoid.
2[9] Opening, dorsal aspect, for optic nerve.
3[9] Material lining it.
1[10] Connective tissue.
2[10] Fat, or adipose tissue.
3[10] Blood vessels and nerves.
1[11] Protruded eyes in strangulation.
2[7] Eyelids.
1[8] Folds of skin strengthened by cartilage.
2[8] Moved by muscles.
3[8] Purpose, a protection to the eye.
4[8] Covering.
1[9] Outside, skin.
2[9] Inside, conjunctiva or mucous membrane.
1[10] Conjunctiva also covers front of eyeball.
1[11] *Plica semilunaris* or semilunar fold.
1[12] Remnant of nictitating membrane or third eyelid.
2[12] Noticable in inner canthus.
5[8] Upper eyelid larger and more mobile than lower.
6[8] Muscles of eyelids.
1[9] Orbicularis palpebrarum closes eyelids.
2[9] Levator palpabrae superioris raises upper eyelid.
7[8] Canthi at outer and inner angles.
1[9] Lachrymal papillae near inner canthus—2.
2[9] Caruncula lachrymalis, quite in the inner corner.
1[10] Caused by a collection of sebaceous glands imbedded in semilunar fold.

3[9] Size of eye principally dependent on distance between canthi.

8[8] Meibomian glands, 20 30.

1[9] Located on edges of lids.

2[9] Abnormal secretion of, glues lids together.

9[8] Eyelashes.

1[9] One or two rows.

2[9] Purpose, to modify light and keep out particles.

10[8] Ptosis or blepharoptosis.

1[9] Indicates paralysis of elevator muscle, and serious indication of disease of brain-parts.

11[8] Diseases of lids: granulated lids, etc.

3[7] Lachrymal apparatus.

1[8] Lachrymal or tear gland.

1[9] Location in upper outer part of orbit.

2[9] Size, almond.

3[9] A compound racemose gland.

4[9] Ducts, 12 to 14, open on eyeball at upper outer corner.

5[9] Lachrymal canals, two.

1[10] Draws off tears.

2[10] Each begins at punctum lachrymalis of each papilla.

3[10] End at lachrymal sac, after uniting.

1[11] Located in hollow formed by lachrymal and superior maxillary bones.

2[11] Nasal duct leads from lachrymal sac into posterior nasal chamber.

3[11] Finally tears reach pharynx and unconsciously swallowed.

4[10] Lachrymal canals often closed and tears running over face.

6[9] Weeping an excessive secretion of gland.

1[10] "Gulping down of passions" by child.

1[11] Extra flow into pharynx needs swallowing.

4[7] Muscles of eye, six.

1[8] Straight muscles.

1⁹ One superior rectus.
2⁹ One inferior rectus.
3⁹ One external rectus.
1¹⁰ If too short, a "wall eye" or a divergent, strabismus.
4⁹ One internal rectus.
1¹⁰ If too short a "cross eye" or convergent strabismus.
2⁸ Oblique.
1⁹ Superior oblique or pulley muscle. (trochlear).
2⁹ Inferior oblique muscle.
3⁸ Squint caused by lack of co-ordination.
1⁹ Left external squint caused by paralysis of left inner rectus.
2⁹ Left internal squint caused by paralysis of left external rectus.
4⁸ Nerves of: third, fourth, and sixth.
5⁷ Eyebrows.
2⁶ Globe of eye or eyeball. *
1⁷ Shape, spheroidal.
1⁸ Antero-posterior diameter, $\frac{8}{9}$ in., (22.5 mm.).
2⁸ Lateral diameter, 1 in., (25 mm.).
2⁷ Coats.
1⁸ Outer coat or first.
1⁹ Sclerotic, posterior $\frac{5}{6}$ of eye.
1¹⁰ Color, opaque and white, "white of eye."
2⁹ Cornea, anterior $\frac{1}{6}$ of eye.
1¹⁰ Color, transparent.
2¹⁰ Membrane of Descemet, lining cornea on posterior aspect.
3⁹ Composed of dense, tough, strong, connective tissue.
4⁹ Absence of blood vessels.
5⁹ Canal of Schlemm at junction of sclerotic and cornea.

*Dissections of eyes of beef should by all means be made, both in their raw state and after they are boiled. The openings might be made in front or on the side.

2[8] Second coat.
1[9] Choroid, posterior $\frac{5}{6}$ of tunic.
1[10] Blood vessels and connective tissue.
2[10] Dark pigment granules in it.
2[9] Ciliary processes, 60–80.
1[10] Choroid thrown into plaits.
3[9] Iris, colored part of eye outside of pupil.
1[10] Central aperture in it, pupil.
1[11] Retina seen through it.
2[10] Muscles in it, ciliary: holds lens in place, etc.
1[11] Circular, to narrow pupil.
2[11] Radiating, to dilate pupil.
3[10] Blue eyes, pigment located deep.
4[10] Albinos.
4[9] Canal of Petit and zone of Zinn.
3[8] Third coat.
1[9] Retina.
1[10] Extends forward only to ciliary processes.
2[10] Optic mound at entrance of optic nerve.
1[11] Elevation produces blind spot.
2[11] Optic nerve entering a little to inward side.
1[12] Optic artery entering eye in center of nerve.
3[10] Macula lutea or yellow spot nearly at posterior center and outside of optic mound.
1[11] Fovea centralis in its center formed because of thinned retina.
4[10] Bounded internally by exceeding delicate membrane, *membrana limitans*.
5[10] Microscopic structure of retina.
1[11] Principally ten layers, except at yellow spot and optic mound.
1[12] From front to back.
1[13] Internal limiting membrane, accessory part.
2[13] Nerve-fiber layer—sensory.
3[13] Nerve-cell layer—sensory.
4[13] Inner molecular layer—sensory.
5[13] Inner granular layer—sensory.

6[13] Outer molecular layer—sensory.

7[13] Rod and cone fiber layer—sensory.

8[13] External limiting membrane—accessory apparatus.

9[13] Rod and cone layer—sensory.

1[14] Sight sensations first aroused in this.

10[13] Pigmentary layer—sensory.

11[13] Radial fibers of Muller radiate through all and is accessory.

3[7] Refractory media of eye.

1[8] Cornea.

2[8] Aqueous humor.

1[9] Between front of lens and back of cornea.

1[10] Iris divides space into anterior and posterior portions.

2[9] Chemical nature, water with a few solids as common salt.

3[8] Crystalline lens.

1[9] Colorless, transparent, and bi-convex.

2[9] Often removed by physicians because of cataract, etc.

3[9] Suspensory ligament holds it in place.

1[10] Ligament formed by anterior division of hyaloid membrane.

4[8] Vitreous humor.

1[9] Enveloped in hyaloid membrane.

1[15] Canal of Petit formed by hyaloid splitting.

2[9] Chemical compounds.

1[16] Water, common salt, mucin, albumin.

4[7] Study of light properties in relation to the eye.

1[8] Light a form of movement of particles of ether.

2[8] Kinds of light as to periods of oscillation.

1[9] Monochromatic, or simple light.

1[10] Periods of oscillation equal.

2[9] Mixed or compound light.

3[8] Capability of rays of light being both *refracted* and *reflected*. Dioptrics and catoptrics.

1⁹ We see objects because of reflection on the object and refraction in our eye.
2⁹ Refraction deviates light rays most, having greatest periods of oscillation.
1¹⁰ Refraction in white or mixed light.
2¹⁰ Only middle rays excite in us visual sensations. spectrum.
4⁸ Camera obscura and eye.
1⁹ Inverted image.
2⁹ Refraction in eye, practically three surfaces.
1¹⁰ At surface of cornea and hence aqueous humor 1.3379. (air 1).
2¹⁰ At surface of aqueous humor and lens, average, 1.4545.
3¹⁰ At surface of lens and vitreous humor 1.3379.
3⁹ Accommodation in both.
1¹⁰ Accommodation in eye because of lens and ciliary muscle.
5⁸ Different sight.
1⁹ Normal eye—emmetropic.
2⁹ Short-sighted eye—myopic: (*myopia*).
1¹⁰ Eyeball too long.
2¹⁰ Need, concave spectacles.
3¹⁰ Rays meet in front of retina.
4¹⁰ Character mark: a peculiarity.
3⁹ Long-sighted eye—hypermetropic: (*presbyopia or presbytia*).
1¹⁰ Eyeball too short.
2¹⁰ Rays meet behind retina.
3¹⁰ Need convex glasses.
4¹⁰ Common in old persons.
4⁹ Amblyopia, hysterical amblyopia, or hysterical blindness.
1¹⁰ Cause, a loss of will, a species of hypnotism.
5⁷ Hygiene of eye.
1⁸ Greatest care should be used.
2⁸ Long or short-sighted persons should be supplied with suitable glasses.

3[8] Excessive reading and study should not be permitted during twilight.

4[8] "Wall and cross eyes" treated.

6[7] Optical defects of eye.

1[8] Due to curvature of refractive surfaces.

1[9] Chromatic aberration or aberration of refrangibility.

2[9] Spherical aberration or aberration of sphericity.

1[10] Avoided by opaque iris cutting off rays.

2[10] Avoided by outer layer of lens being less refracting than inner.

3[9] Irregularities in curvature.

1[10] Astigmatism and peculiarly shaped glasses to counteract.

2[8] Due to opacities in refracting media, entoptic.

1[9] Cataract, lens opaque.

2[9] Opacities from ulcers or wounds.

3[9] *Muscae volitantes* in vitreous humor.

7[7] Localizing power of retina.

8[7] Color vision.—Young's theory of it, also Hering's.

1[8] Black not a color physically but is in consciousness.

9[7] Color blindness: absence of color sensation.

1[8] Red color blindness or "Daltonism."

1[9] One man in eight red blind, less in women.

2[8] Green and violet color blindness also at times.

3[8] Value of test in railroad officials and sailors.

4[8] The poet, Whittier, is said to have been color blind.

10[7] Fatigue of retina.

11[7] Visual perceptions.

1[8] Of distance.

2[8] Of size.

3[8] Of space.

4[8] Of singleness or monocularity.

1[9] Binocular vision.

5[8] Of solidity.

6[8] Of shine.

1[9] Light reflected in brilliant points.

2[9] Depends upon non-agreement of light and dark points in the same or different eyes.

2[4] Auditory apparatus.

1[5] Ear.

1[6] Parts.

1[7] External ear.

1[8] Parts of it.

1[9] Pinna or auricle, projection on outside.

1[10] Helix, outer edge of it.

2[10] Anti-helix, below helix.

3[10] Tragus, protrusion in front of concha.

4[10] Anti-tragus, protrusion behind concha.

5[10] Lobule, lower protrusion of ear.

6[10] Concha, opening leading into meatus.

7[10] Fossa of helix between helix and anti-helix.

8[10] Fibro-cartilage stiffens pinna.

2[9] External auditory meatus.

1[10] Closed by drum or tympanic membrane.

1[11] Concave without and convex within.

2[10] Secretion of wax by ceruminous glands located within lining membrane.

1[11] Nature and purpose of the cerumen.

3[10] Length 1¼ inches.

4[10] Numerous hairs located in it.

5[10] In tympanic bone.

2[7] Tympanum or middle ear.

1[8] ocation in petrous bone.

2[8] Eustachian tube leads from it to pharynx.

1[9] Mucous membrane continued up this tube, lining cavity.

1[10] Tympanic membrane between mucous membrane within and skin outside.

2[9] Equalizes pressure without and within.

1[10] Why swallow in ascending in a balloon or descending into a mine?

3[8] Inner wall bony except at.

1[9] Round foramen.

1[10] Closed by lining mucous membrane.

2[9] Oval foramen.

1[10] Closed by stapes fitting over it.

NOTE.—*Transmission* of sound through foramens 1[9] and 2[9].

4[8] Auditory ossicles found in it.

1[9] External bone—malleus or hammer.

1[11] Parts of.

1[12] Head.

1[13] Attached to incus.

2[12] Neck.

1[13] Axial ligament.

3[12] Processes below neck.

1[13] Long or slender process.

1[14] Attached to ligament reaching to drum.

2[13] Handle.

1[14] Attached to drum membrane direct.

2[14] Tensor tympani muscle.

2[9] Second bone—incus or anvil.

1[10] Parts, body and two processes.

1[11] At end of long process, in adult a knot, in youth a distinct bone, *os orbiculare*.

3[9] Third and last—stapes or stirrup.

1[10] Fits on oval foramen.

2[10] Stapedius muscle attached to it.

1[11] Limits range of movement in *fenestra ovalis*.

3[7] Internal ear—labyrinth.

1[8] Divisions.

1[9] Bony labyrinth.

1[10] Description.

1[11] Parts.

1[12] Vestibule.

1[13] Central part.

2[13] Oval foramen on its exterior.

1[14] Stapes fits into it.

3[13] Round foramen in it.

2[12] Semicircular canals—three in number.

1[13] Location behind vestibule and above.
2[13] Communication with vestibule.
3[13] Ampulla, dilation at junction with vestibule.
3[12] Cochlea.
1[13] Shape as of a tube coiled on itself.
2[13] Great point of entrance of auditory nerve.
1[14] Auditory nerve sends branches to ampulla.
2[10] Perilymph in it around membranous labyrinth.
3[10] Location, in petrous temporal.
2[9] Membranous labyrinth.
1[10] Lies within bony labyrinth.
2[10] Parts.
1[11] Vestibule.
1[12] Parts of.
1[13] Utriculus—posterior.
1[14] Membranous semicircular canals open into it.
2[13] Sacculus –anterior.
1[14] Communicates with utriculus by narrow aperture.
2[12] Ear stones or otoliths and *cupula terminalis*.
3[12] Hair cells.
2[11] Semicircular canals.
1[12] Closely connected to periosteum of bone in ampulla, at entrance of nerve.
2[12] Resemble bony canals much.
3[12] Hair cells.
3[11] Cochlea.
1[12] Organ of Corti.
1[13] Contains end organs of cochlear nerve.
2[13] Inner hair cells.
3[13] Rods of Corti.
1[14] Inner, 6000.
2[14] Outer, 4500.
1[15] Reticular membrane.
4[13] Tectorial membrane over rods of Corti and hair cells.

2^{12} Modiolus and lamina spiralis.

3^{12} Scala vestibuli and scala tympani.

3^{13} Filled by endolymph.

2^{5} Auditory nerves.

1^{6} Origin, pons Varolii.

2^{6} Divide into two divisions at first, which subdivide.

3^{5} Sounds.

1^{6} How considered.

1^{7} Physically: exist whether there be an ear or not.

2^{7} In consciousness: need of an ear.

2^{6} Sounds as sensations.

1^{7} Notes—periodical.

1^{8} Loudness or intensity.

1^{9} Dependent on force of aerial waves.

2^{8} Pitch.

1^{9} Dependent on length of waves or number of waves reaching ear in given time.

2^{9} Highest pitched audible notes 38016 vibrations.

3^{9} Impossibility of some hearing cry of bat or chirp of cricket, almost highest limit.

3^{8} Timber, dependent on wave form.

4^{5} How we hear.

1^{6} Sound waves strike tympanic membrane.

2^{6} Tympanic membrane vibrates.

3^{6} Auditory ossicles and air of tympanum set in motion.

4^{6} Perilymph set in motion through oval and round foramens.

5^{6} Membranous labyrinth and its endo-lymph set in motion.

6^{6} An auditory sensation the result because of movement, and contact of nerve.

3^{4} Touch.

1^{5} Located in skin.

1^{6} Generally accompanying hair.

1^{7} Hair, whiskers of cat, tiger, etc.

2^{7} Irritation of hair causes feelings more quickly.

2^5 Some peculiar nerve end organs.

1^6 End bulbs.

1^7 Spheroidal, about $\frac{1}{300}$ inch in diameter.

2^7 Core, connective tissue capsule with two or three nerve-fibers.

3^7 Located in red part of lips, in conjunctiva, and mucous membrane of soft palate and tongue.

2^6 Pacinian or Vater corpuscles.

1^7 Location.

1^8 In subcutaneous tissue of hand and foot.

2^8 About knee-joint and branches of solar plexus.

2^7 Doubtful whether they are true touch organs.

3^7 Size.

1^8 $\frac{1}{15}$ to $\frac{1}{10}$ inch long and $\frac{1}{2}$ that width.

4^7 Parts.

1^8 Core.

1^9 Axis cylinder of nerve-fiber in core.

2^8 Many concentric capsules surrounding core.

3^6 Tactile corpuscles or corpuscles of Meissner and Wagner.

1^7 Found in papillae of dermis.

2^7 Oval, $\frac{1}{300}$ inch in length.

3^7 Numerous in hand and foot.

4^7 Two, three, or more nerve-fibers go to each core.

4^6 Touch cells.

1^7 Similar to tactile corpuscles but only one nerve-fiber.

2^7 All over skin.

3^5 High cultivation of it in many persons.

1^6 In the blind. *

2^6 In persons testing money for government.

4^5 Localizing power of touch sensations.

1^6 In the object.

2^6 In ourselves.

*The author once formed the acquaintance of a blind man, who is said to have taken a watch a-part and put it together again successfully at first trial.

3[6] Accuracy in different organs in determining both points of a compass.

1[7] Tongue tip..... .04 inch.
2[7] Palm side of last phalanx of finger..... .08 inch.
3[7] Red part of lips..... .16 inch.
4[7] Tip of nose..... .24 inch.
5[7] Back of second phalanx of finger..... .44 inch.
6[7] Heel..... .88 inch.
7[7] Back of hand.....1.23 inch.
8[7] Forearm.....1.58 inch.
9[7] Sternum.....1.76 inch.
10[7] Back of neck.....2.11 inch.
11[7] Middle of back.....2.64 inch.

4[4] Temperature sense.

1[5] Knowledge of heat and cold.

2[5] Stronger in some parts than in others.

1[6] Application of smoothing iron to cheek or to finger, in ironing.

3[5] Temperature sense more acute within a few degrees of 30°C. (86°F.)

1[6] At this temperature less than .1°C. can be discriminated.

5[4] Smell.

1[5] Nerve of, olfactory.

1[6] Origin olfactory lobes.

2[5] Olfactory organ.

3[5] Schneiderian membrane, the mucous membrane of nose.

1[6] Ending of olfactory nerve found in it.

2[6] Part affected in cold and catarrh.

1[7] Discharge of mucus.

4[5] Region of it—(regio olfactoria).

1[6] Upper and lower turbinate bones.

2[6] Septum of nares.

3[6] Roof of nose.

5[5] Easy excitation of it.

1[6] Grain of musk giving off odor for years with scarcely a diminution of weight.

2^6 Some gases do not stimulate smell.

3^6 Gases needed for smell.

6^4 Taste.

1^5 Located on dorsal aspect of tongue, principally.

2^5 Nerves of taste.

1^6 Glosso-pharyngeals over hind part of tongue.

2^6 Lingual branches of inferior maxillary division of trigeminales.

1^7 Location, anterior $\frac{2}{3}$ of tongue.

3^5 Taste buds along with circumvallate papillae.

1^6 Some have been discovered with fungiform papillae.

4^5 Many so-called tastes are smells.

5^5 Intellectually of small value.

6^5 Sense of taste probably because of taste cells.

7^5 Things tasted in region where no taste buds can be found.

8^5 Divisions of taste proper.

1^6 Sweet, bitter, acid, saline.

1^7 Bitter best tasted with back of tongue?

2^7 Sweet best tasted on tip?

9^5 Only dissolved substances can be tasted.

7^4 Muscular.

1^5 The idea of weight and resistance.

NOTES.

1. Aqueous—Lat., *aqua*, water.
2. Auditory—Lat., *audire*, to hear.
3. Ampulla—Gr., *amphi*, on both sides, and—Lat., *olla*, pot or jar.
4. Canthus—Gr., *kanthos*, the corner or angle of eye.
5. Cornea—Lat., horny; front part of eye is horny in structure.
6. Choroid—Gr., *chorion*, skin, and *eidos*, form.
7. Cochlea—Lat., a snail.
8. Endolymph—Gr., *endon*, within, and *lympha*, water.
9. Fovea centralis—Lat., *fovea*, a pit, and *centralis*, central.
10. Iris—Gr., *iris*, *iridos*, the rainbow.
11. Labyrinth, an intricate or involved inclosure.
12. Myopia—Gr., *mygein*, to close, and *opos*, the eye.
13. Presbyopia—Gr., *presbys*, an old man, *opos*, the eye.
14. Pinna—Lat., *pinna*, *penna*, a feather.
15. Perilymph—Gr., *peri*, around, and (Lat.) *lympha*, water.
16. Pacinian, from the name Pacini, an Italian anatomist.

17. Retina—Lat.. *rete*. a net.
18. Sclerotic—Gr.. *skleros*. hard.
19. Stapedius—Lat.. *stapes*. stirrup.
20. Semicircular—Lat.. *semi*. half. and *circle*.
21. Sacculus—Lat.. diminutive of *saccus*. a sack.
22. Tympanum—Gr.. *tympanon*. a kettle drum.
23. Utriculus—Lat.. diminutive of *uter*. a bag or bottle made of an animal's hide.
24. Vitreous—Lat.. *vitrum*. glass

1. Narcotics and Stimulants.

1¹ Distinction of the two.

2¹ Narcotics.

1² Definition.

1³ Medical meaning.

1⁴ A substance which lessens our relation to the outer world. (*Dr. Darby, West. Reserve Med. College*).

2⁴ A substance which promotes or artificially imitates the natural physiological properties of sleep. (*Med. Dict., Thomas*).

2³ Restricted meaning.

1⁴ Stupefying poison for which habit is formed.

2² Distinction from hypnotic, anaesthetic, and stimulant.

1³ Anaesthetic—a substance having the power of rendering the recipient insensible to pain. (*Med. Dict., Thomas*).

2³ Restricted meaning.

3³ Stimulant—a substance having the power to excite the organic action of an animal or increase the vital activity of an organ. (*Med. Dict., Thomas*).

3² General effects of all narcotics.

1³ Do not as a rule produce lesions of the Body, alcohol does.

2³ They principally produce functional alterations.

3³ They chiefly affect nervous system, and finely organized organs in general.

4² Circumstances leading to their use.

1³ Painful ailments.

2³ Indiscreet medication, both of patient and physician.

3³ Hunger, thirst, idleness, a wrong idea of true manhood, etc.

4³ Association.

1⁴ With companions.

2⁴ With drugs themselves: (habit of their use).

3⁴ With sensational literature.

4⁴ With a thoughtless mind.

5² Narcosis or narcotism.

1[3] Effect of narcotic, stupor or profound torpor and coma.
6[2] Principal narcotics.
1[3] Alcohol.
1[4] General description.
1[5] Transparent and colorless when pure.
2[5] Elements of, carbon, hydrogen, and oxygen.
3[5] Chemical formula.—C^2H^6O.
4[5] Specefic gravity less than water; 820.
5[5] Boils at low temperature, highly inflammable, burning with a bluish flame.
1[6] Boiling point 172.9° F. [78.3°C.].
6[5] Essential constituent of all fermented and distilled liquors.
1[6] Per cent of alcohol in alcoholic beverages commoly used. *
1[7] Fermented.
1[8] Malt liquors, beer, ale, stout, and porter.
1[9] Beer—3 to 10%, may be 2%.
2[9] Ale—6 to 10%.
2[8] Cider and perry: cider 3 to 10%.
3[8] Wines, claret, sherry, port, champagne, catawba, and madeira.
1[9] Champagne 5 to 10%: port 16 to 25%.
2[9] Madeira 16 to 25%: claret 7 to 9%.
2[7] Distilled.
1[8] Whiskey—50 to 60%.
2[8] Rum—60 to 70%.
3[8] Brandy—50 to 60%.
4[8] Compounds formed, gin, cherry brandy, pineapple rum, etc.

*This percentage composition is given on the ordinary natural outcome, but as liquors are ordinarily prepared to-day, nothing is too bad to think of what might be contained in them. Alcohol is a rank poison but what words are strong enough for the other digusting and loathsome poisons placed into these liquors by men who have no respect either for themselves or the ethical in man, who carve their fortunes by making wrecks of humanity and happy homes, casting their slough on society for honest men to care for.

"Among the poisonous substances largely used in adulterations are white lead, sugar of lead, copperas, logwood, alum, opium, aloes, tobacco, nux vomica, arsenic, strychnine, and sulphuric acid."—Eclectic.

5[5] Liquors formed by addding essences to spirits.
6[5] Alcohol, ordinary—75%.
7[5] Alcohol, absolute—95%.
8[5] Distilled liquors derived from fermented.
2[4] Uses of alcohol.
1[5] As a preservative.
2[5] As a special solvent, gums, oils, and resins.
1[6] Hence use in varinshes.
3[5] As a medicine. (?)
4[5] In chemical laboratories.
1[6] As a re-agent.
2[6] As a fuel in place of gas.
3[4] Is alcohol a food? *
1[5] Does no good to healthy Body, and never necessary.
2[5] Dangerous to use even in moderation.
3[5] Purpose is, that of a whip in case of disease.
1[6] Dangerous to integrity of organs.
2[6] Is the whipping nourishing?
4[5] Diminishes amount of carbon dioxide exhaled, hence oxidation.
5[5] Takes oxygen from tissues and no increase of oxygen supply, possibly diminishes power of using oxygen left behind.
6[5] Lowers heat of Body.
1[6] May make outside warmer but inside cooler.
2[6] Authority of Dr. Hayes, the Arctic explorer. †
7[5] Lowers capability of work power of muscles.
1[6] Experiments on soldiers of Army of Potomac: one gill per day.
1[7] Authority of Dr. Frank Hamilton.

*"So far we have learned that alcohol as a regular article of diet is, at least, useless. Were that all, we might regret the annual waste of corn, barley, wheat, and fruits in its production: and think the man *foolish* who spent his money on it. In such case the matter would be one for moralists and political economists to deal with, and physiologists and students of hygiene might leave it alone. Unfortunately, alcoholic drinks are not merely useless but positively hurtful, when taken regularly, even in what is usually called moderation. Alcohol has probably caused in the past, and is certainly causing at present in civilized nations, more disease and death than either *'bad drainage, bad ventilation, overcrowding, deficient food, overwork, or any other of the conditions prejudicial to health concerning which Physiology and Hygiene warn us.'* (*Martin.*)

8[5] Tends to produce disease.

9[5] Does not lead to development of useful tissue.

1[6] Abnormal accumulation of fat and that where of least value, *fatty degeneration*.

10[5] Shrivels proteids of stomach wall if empty, or proteids of food, if full.

1[6] Coagulates albumen of brain. Test white of egg and alcohol.

11[5] Enters blood unchanged and does not relieve hunger.

12[5] A very slight amount can be oxidized in 24 hours. (1—1½ oz. of absolute alcohol, and 2—5 oz. of ordinary whiskey. *Bartholinus*).

1[6] More can be oxidized in sickness.

13[5] Extracts water from tissues, rapidly.

1[6] Why does a drinker drink so much water?

4[4] Absorption of alcohol.

1[5] Easy diffusion and consequent ready absorption.

2[5] Parts in order reached, beginning with stomach.

1[6] Capillaries of stomach, gastric vein, portal vein, liver, hepatic veins, inferior vena cava, heart, lungs, and heart to all parts of Body.

5[4] Effects of alcohol. [Has close relation to 3[4]].

1[5] Stage of stimulation always precedes narcotic effect.

2[5] Primary effects of, on Body.

1[6] Effects of moderate quantity.

1[7] Temporary congestion of stomach.

2[7] Dilation of blood-vessels of skin.

1[8] Due to effect on sympathetic nervous system and rapid heart beat.

3[7] Apparent rise of temperature. [Due to 2[7]].

4[7] Final fall of temperature.

† "While fresh animal food, and especially fat, is absolutely essential to the inhabitants and travellers in Arctic countries, alcohol is, in almost any shape, not only completely useless but positively injurious * * * * * * I have known the most unpleasant consequences to result from the injudicious use of whiskey for the purpose of temporary stimulation, and have also known strong able-bodied men to have become utterly incapable of resisting cold in consequence of the long-continued use of alcoholic drinks." Dr. Hayes.

1[8] Due to decreased metamorphosis of tissue.
5[7] Nervous excitement.
1[8] Restlessness, talkativeness, incoherence of ideas, and often giddiness.
6[7] Tendency to sleep in narcotic effect.
7[7] Depression on awakening.
2[6] Effects of larger quantity.
1[7] Giddiness accompanied by diminution of sensibility of skin.
2[7] Imperfect control of voluntary muscles.
1[8] Muscles moving eyeballs cease to work in harmony.
1[9] Final double sight.
2[8] Staggering gait and defective articulation.
3[8] Irritation of stomach and consequent vomiting.
4[8] Drunken sleep.
5[8] Headache, loss of appetite, and marked prostration.
6[8] Continuance gives way to functional and structural diseases.
3[5] Secondary effects: functional and structural. *
1[6] Minor diseased curable conditions.
1[7] Alcoholic dyspepsia.
2[7] Tremor or shakiness of hand.
3[7] Large numbers, not knowing the cause, suffer from them.
4[7] Will power not seriously impaired.
5[7] Abstinence from use followed by recovery.
2[6] Acute alcoholic diseases.
1[7] Delirium tremens.
1[8] More frequently the result of long drinking which has never culminated in drunkenness.

*"*The disgusting appearance of a drunken man, the loathing which he excites even in those most attached to him, the loss of control over his actions, which makes him the prey of criminals, or, yet worse, a criminal himself, taken together make a picture to which the physiologist need add nothing. A man not deterred by its contemplation will not be hindered in the indulgence of his appetite by any argument based on injury to his health."* Law should find a way by which the appetite can be controlled and the lives of individuals preserved in their purity.

2[8] Nature's unmistakable warning to the tippler.

2[7] Dipsomania.

1[8] Case of Luther Benson.

2[8] Horrors of drink in its inheritance.

3[6] Chronic and often incurable diseased conditions.

1[7] Deterioration of tissue.

1[8] Fatty degeneration.

1[9] Cause.—over stimulation of organ.

2[9] How manifested?

1[10] Increase of adipose tissue.

2[10] Increase of fat droplets in cells.

3[4] "Whiskey heart" and fatty liver.

2[8] Fibrous degeneration or excessive growth of connective-tissue.

1[9] "Hob-nailed or gin-drinker's liver": shrunken.

1[10] Prevents proper manufacture of bile and glycogen.

2[10] Impedes drainage of blood from other organs by portal vein.

3[10] Excess watery part oozes into peritoneal cavity, (abdominal dropsy or *ascites*).

2[9] Kidney substance proper, crushed.

1[10] "Bright's disease."

1[11] Elimination of albumen.

2[11] Retention of proteid wastes in blood.

3[11] Sub-cutaneous dropsy—*anasarca*.

2[7] Principal organs most likely to be impaired or destroyed by alcohol.

1[8] Final effects on skin.

1[9] Permanent congestion.

2[9] Appearance of pimples where circulation is more feeble.

3[9] Imperfect nutrition of epidermis and collection into scaly masses.

4[9] Proper action of sweat glands interfered with.

1[10] Increased labor thrown on kidneys.

2[8] Effects on stomach.

1[9] Vessels remain dilated and congested.
2[9] Its connective tissue becomes excessive.
3[9] Power of secreting gastric juice diminished.
4[9] Mucous secretion abnormally abundant.
5[9] Fibrous degeneration of walls.
1[10] Crushing out of cells of glands.
6[9] Ulceration of walls of stomach.
7[9] Effects on digestion.
1[10] Precipitation of pepsin.
2[10] Hardening of proteids of food.
3[10] Various forms of indigestion.
3[8] Effects on liver.
1[9] One of the first organs attacked.
1[10] Blood carried from stomach to liver in portal vein.
2[9] Primary effects.
1[10] Increased in functional activity.
1[11] More abundant secretion of bile.
2[11] Increase of connective tissue.
3[9] Final effects.
1[10] Fatty degeneration.
1[11] Breaking down of cells and decreased functional activity.
1[12] One function of liver is to prepare nitrogenous waste for kidneys.
2[10] Fibrous degeneration.
1[11] "*Hob-nailed or gin-drinker's liver.*"
2[11] *Ascites* or abdominal dropsy.
1[12] Cause, failure of portal circulation to draw off blood.
4[8] Effects on heart.
1[9] Primary effects.
1[10] Increased functional activity.
2[10] Walls thickened.(*hypertrophied*).
2[9] Final effects.
1[10] Fatty degeneration.
1[11] Walls turn fatty.

2[11] Adipose tissue deposited around heart.

3[11] Possibility of walls rupturing.

4[11] Decreased functional activity.

1[13] Consequent deleterious effects on all parts of Body.

5[11] "Whiskey heart."

5[7] Effects on arteries.

1[9] Fatty degeneration and loss of strength and activity.

2[9] Liability to rupture or to *aneurism*.

6[8] Effect on kidneys.

1[9] Primary effects.

1[10] Increase in functional activity and of connective tissue.

2[9] Secondary effects.

1[10] Fatty degeneration.

1[11] Breaking down of cells.

2[10] Fibrous degeneration.

1[11] "Bright's disease."

3[10] Nitrogenous waste of Body not properly prepared by liver.

4[10] Gout and rheumatism produced.

7[8] Effects on lungs.

1[9] Causes frequent attacks of cold and bronchitis.

2[9] Cause of peculiar form of consumption, rapidly fatal: "Alcoholic Phthisis."

1[10] Found only in alcoholic drinkers.

8[7] Effects on special sense organs.

1[9] Acuteness of perception dulled.

2[9] Believed to be cause of cataract and retinal disease by many physicians.

9[7] Effects on nervous system, (brain, etc).

1[9] Primary effects.

1[10] Increase of functional activity.

2[10] Disorder by excitement.

3[10] Loss of consciousness.

1[11] Probably due to increased blood depression.

4[10] Chronic state of congestion and disorderly excitement.

1[11] *Delirium tremens.*

2[9] Final effects.

1[10] Fatty degeneration of cells.

2[10] Fibrous degeneration and increase of connective tissue.

1[11] Shrinking of it.

3[10] Coagulation of albumen of system.

4[10] Shrinking of nervous substance.

5[10] Epilepsy in one form, especially.

4[8] Body liable to disease and dangerous bacteria.

5[8] Prepares criminals and for death of innocent.

6[4] Moral deterioration produced by use of alcohol.

1[8] Will enfeebled and finally lost.

2[8] Respect of others and for self lost.

3[8] Passion for drink satisfied at any cost.

4[8] Really a lunatic needing an asylum.

2[3] Opium.

1[4] Description and source.

2[4] Market forms.

1[8] Gum opium, the crude substance.

2[8] Laudanum, an alcoholic extract of the gum.

3[8] Paregoric.

4[8] Morphia and its compounds.

5[8] Dover's powders.

3[4] Methods of using.

1[8] By mouth.

2[8] By hypodermic injection.

3[8] By smoking.

4[4] Opium habit.

1[8] Very binding and worse than alcohol because of secret indulgence.

5[4] Effects produced.

1[8] Primary.

1[6] Deadening of sensibility and energy.

2[6] Unnatural sleep and fantastic dreams.

3[6] Muscular weakness and shriveling of skin.
4[6] Distaste for food [no nausea] and irresistible craving of another dose.
5[6] Premature age, general dullness, and sluggishness, especially of circulation.
2[5] Final effects.
1[6] Greatly impaired digestion and reduced secretions.
2[6] Failure of nervous system.
3[6] Incomplete paralysis of lower half of Body.
4[6] Death from starvation.
1[7] Due to impaired digestion and respiratory organs.
3[3] Chloral.
1[4] As bad as opium.
2[4] Was thought harmless but should be prohibited by law.
3[4] Description and source.
4[4] Effects of its use.
1[5] Digestion impaired.
2[5] Nausea, vomiting, and dry, furred tongue.
3[5] Nervous and circulatory disturbances.
4[5] Hand and legs tremulous, heart beat irregular, and face easily flushed.
5[5] Will becomes weak, sleep impossible.
6[5] Blood finally altered, and purplish patches on skin.
7[5] Final effect, death.
1[6] Caused by,
1[7] Impoverished blood.
2[7] Weakened heart,
3[7] Paralysis of nervous system, or
4[7] Intentional suicide.
4[3] Tobacco.
1[4] Active principle—nicotine.
1[5] A powerful poison in its pure form, paralyzing heart
2[4] Effects of its use.
1[5] Due to absorbed nicotine in general part.
1[6] More introduced through chewing than smoking.

2[5] Due to acrid vapors of irritant action in local part.

3[5] First effects.

1[6] An increased flow of saliva.

4[5] Secondary effects.

1[6] Dryness of mouth and consequent thirst, leading to alcoholic indulgence.

1[7] The alcoholic desire is the greatest danger.

2[6] Habitual smoker usually suffers from "smoker's sore throat."

1[7] Injury of voice and impairing of hearing.

1[8] Larynx and Eustachian tubes.

3[6] Chronic inflammation of bronchial tubes.

4[6] Cigarettes specially injurious.

1[7] The most disgusting and poisonous matter introduced into them.

5[5] General action or effect.

1[6] Interferes with development of red corpuscles, hence pallor and feebleness.

2[6] Impairs appetite and weakens digestion.

3[6] Renders retina of eye less sensitive and causes palpitation of heart.

4[6] Especially deleterious to growing Body.

5[6] Induces lassitude and indisposition to exertion.

1[7] If success be valuable, why shackle one's self?

3[4] Its use is loathsome to sight and fine culture.

4[4] Tobacco heart.

1[5] Debility of organ and irregular action.

5[4] Never a food. Lethel dose of nicotine produces death in from 3 to 5 minutes.

5[3] Other narcotics.

1[4] Chloroform. $CH Cl^3$.

1[5] A powerful anaesthetic, its particular value.

2[5] A poison and no food.

2[4] Ether. $(C^2H^5)_2O$.

1[5] Valuable as an anaesthetic.

2[5] Use as a habit, deleterious.

3[4] Coca infusion and hydrochlorate of cocaine.

3[1] Stimulants.
1[2] Coffee.
1[3] Active principle—*caffeine*, the stimulant.
2[3] Tranquilizes nervous system and removes sense of fatigue.
3[3] Becomes injurious by excessive use.
4[3] Amount of nourishment in a cup very small.
5[3] Hinders digestion in full meal.
6[3] Probably injurious in youth: not needed.
2[2] Tea.
1[3] Active principle—*theine*.
2[3] Effects about same as coffee only it exerts an astringent action.
3[3] Tannin a product of tea.
1[4] Delays digestion, if tea is strong.
4[3] Its excess produces, nervous tremor, disturbed sleep, palpitation of heart, and indigestion.
3[2] Chocolate.
1[3] Active principle—*theobromine*.
4[2] Nearly all narcotics stimulate at first.

1. The Germ Theory of Disease.

1[1] Bacteria or microbes.

1[2] Not determined fully whether plants or animals.

2[2] Kinds—very many.

1[3] Some harmless to man.

2[3] Dangerous bacteria.

1[4] Growth in tissues and blood.

2[4] Produce some of worst diseases.

3[4] Diseases produced by them.

1[5] Infectious diseases.

1[6] Smallpox, scarlet fever, diphtheria, and measles.

1[7] Each has for its cause a special minute organism.

2[7] Bacteria can be carried in air but more likely to travel by some other method.

2[5] Other diseases possibly produced.

1[6] Typhoid fever, consumption, cholera, yellow fever, blood poisoning, various forms of malarial diseases, colds, etc.

1[7] Some probably semi-infectious.

4[4] Diseases in lower animals caused by them.

1[5] Splenic fever and chicken cholera.

5[4] How prepare to combat them?

1[5] Cleanliness of person.

2[5] Cleanliness of food.

1[6] Many of these bacteria introduced through blood.

1[7] Bad drinking water.

1[8] Sewers, sinks, etc.

2[8] Why should water be thoroughly boiled?

2[7] Food in raw state, especially if exposed to foul air.

3[5] Cleanliness of air and surroundings.

1[6] Value of disinfection.

2[6] Air becomes a carrier.

4[5] Avoid deleterious poisons tending to tear down Body, making it a prey to disease.

1[6] Alcohol and other narcotics specially injurious.

2[6] Smallpox and cholera affect the drinker most severely.

5⁵ A perfectly healthy Body often withstands ravages of bacteria and hence disease.

6⁵ Isolation of sufferers from infectious diseases.

1⁶ Most important.

2⁶ Its neglect criminal.

3² Killing of them.

1³ How killed?

1⁴ By heating to a very high temperature.

2⁴ By washing with a solution of a poison.

1⁵ Corrosive sublimate or carbolic acid.

3⁴ By immersing in a poisonous gas.

1⁵ Burning of sulphur.

2³ Object of disinfection of sewers, etc.

4² Decay of organic substance develops them.

1³ Principally of harmless kinds.

2³ Growth of bacteria makes decay of substance.

3³ Object in canning fruits, preserving meats and other foods.

1⁴ Killing bacteria in substance preserved.

2⁴ Preventing others from reaching them.

1⁵ Exposed food is like a field full of seeds needing only warmth and moisture for growth.

5² Rapid multiplication of them.

1. Reproduction.

1¹ Bi-sexual or by impregnated ova.

2¹ Agamo-genesis or partheno-genesis.

1² A non-sexual body producing by segmentation and fission other similar non-sexual forms.

1³ Blood corpuscle.

2² An animal without sexual contact producing by fissiparation others of its kind.

1³ Fission of polyp or of cell.

3² An animal without sexual contact producing by gemmation, others of its kind.

1³ Polyps, medusae, infusoria, starfish, crab, lizard, or lobster.

1⁴ Lizard's tail knocked off and a new production without death, so with the others.

4² An animal cut in pieces, [surely no sexual contact here] each division producing an individual in all ways similar to, and perfect as the parent before mutilation.

1³ A cut polyp, or earth worm.

5² Nos. 2², 3², and 4² may spring from developed ova or reproduction.

6² A non-sexual being going through three distinct stages, (in as many different individuals) of non-sexual life and at last producing offspring that are non-sexual, then mono-sexual (males) and then finally bi-sexual, (*hermaphrodites*).

1³ Tape worm, (*taenia solium*),

1⁴ Its introduction into our Body.

1⁵ Rat, hog, man.

2³ *Bothriocephalus latus* of beef.

7² Another non-sexual individual producing first, a non-sexual which finally develops a bi-sexual progeny finally becoming females, the male element practically annihilated.

1³ *Taenia perfoliata* or tape worm of a horse.

3¹ Snails, hermaphrodites incapable of self-fecundation.

4¹ Production of bee, drone if non-fecundated.

INDEX.

INDEX.